SCIENTIFIC AMERICAN

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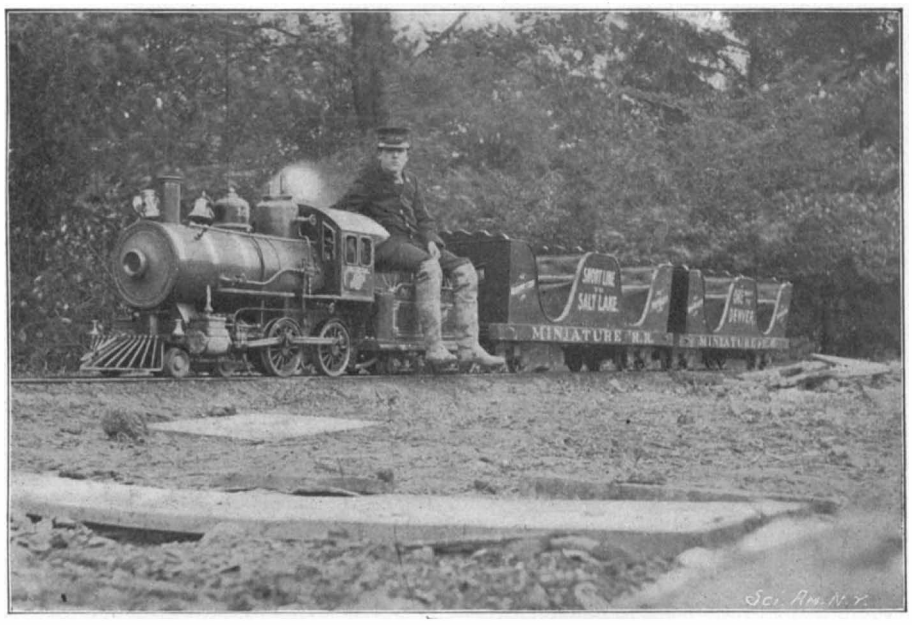
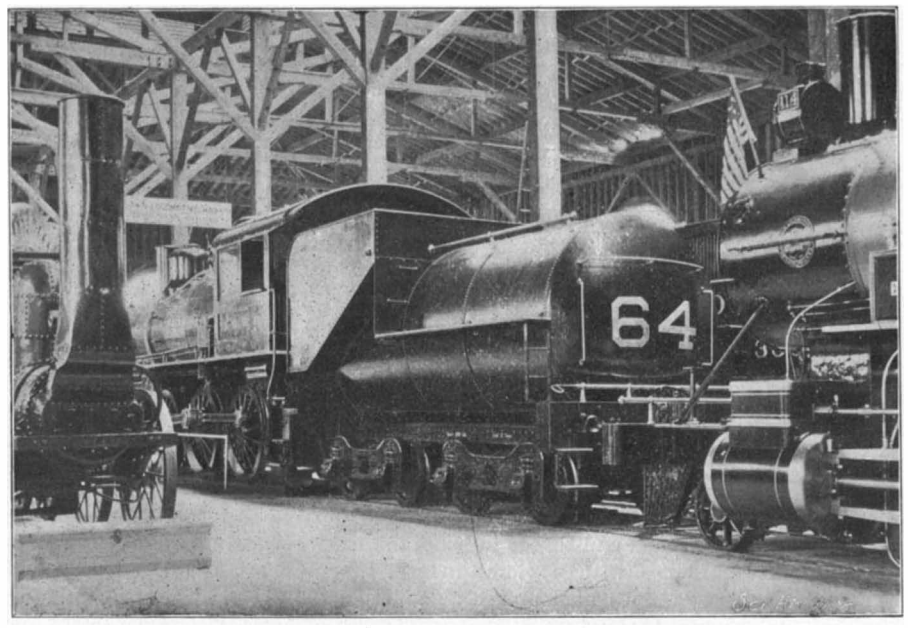
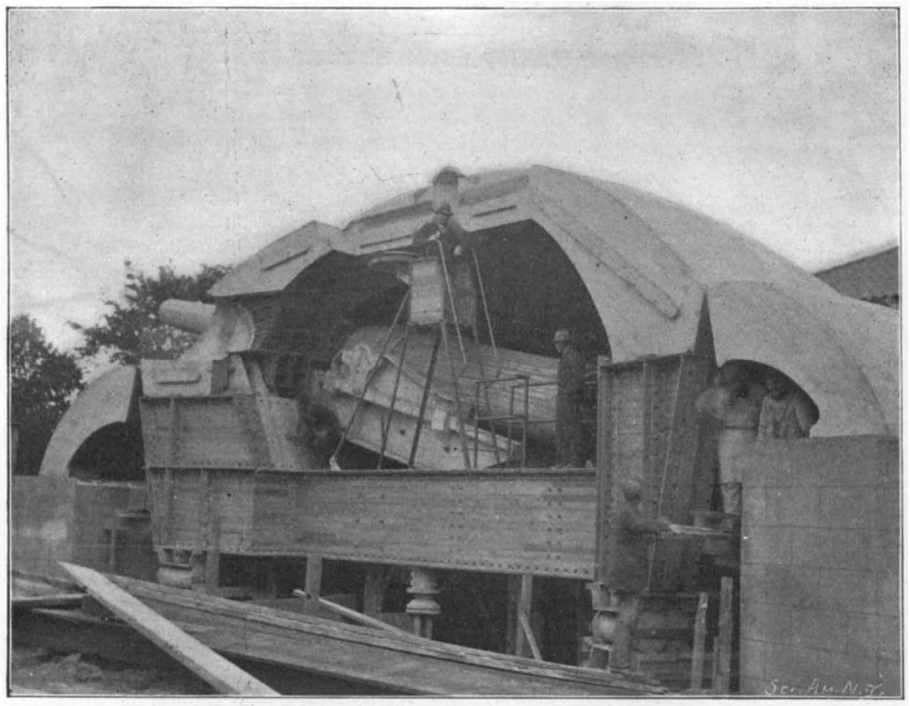


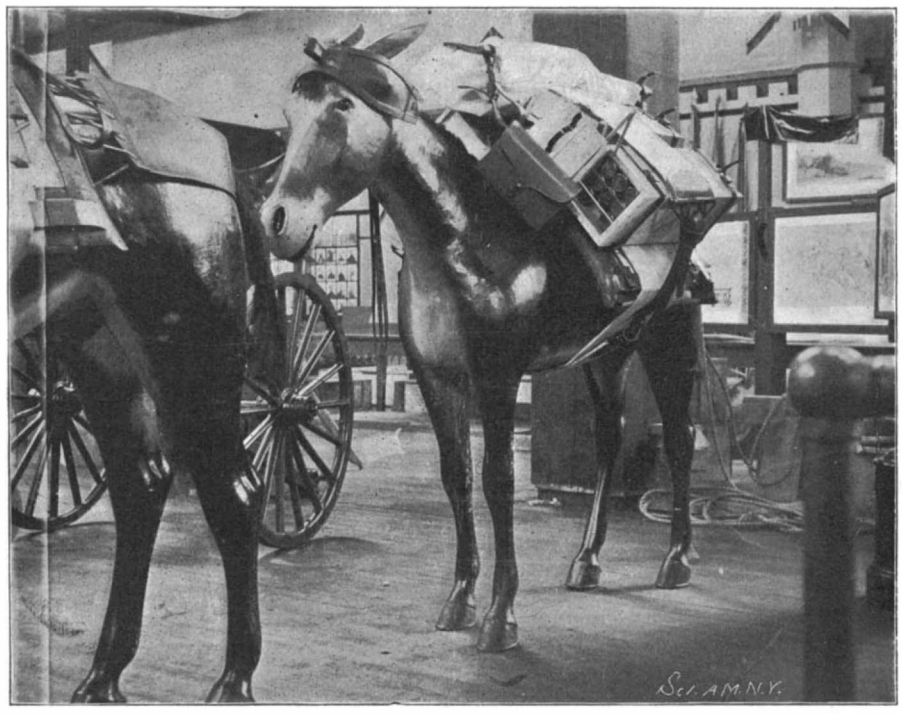
The Miniature Railroad—A Stop in Front of the Ordnance Building.



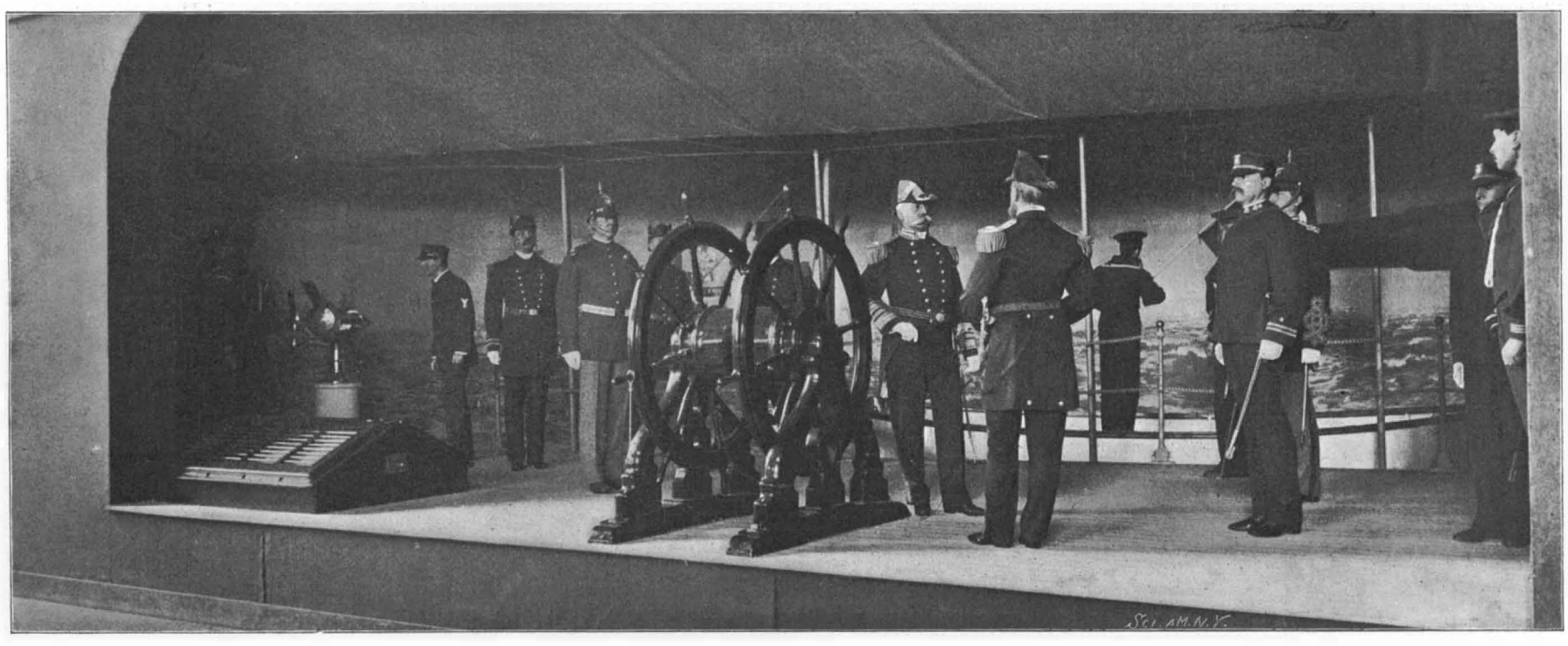
The Vanderbilt Locomotive and Tender.



Model of a Gruson Turret Carrying 12-Inch Guns.



Models of Mountain Artillery Outfits Transported by Mules.



Cyclorama Representing a Portion of a Cruiser with Admiral Dewey and Officers in Full-Dress Uniform.

SOME INTERESTING EXHIBITS AT THE PAN-AMERICAN EXPOSITION.—[See page 23.]

Scientific American.

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NEW YORK, SATURDAY, JULY 13, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THERE IS ROOM AT THE TOP.

Not many months ago a man whose ambition it is to govern the affairs of this city—an ambition, unfortunately, in which he is only too successful—ventured to break the discreet silence that has contributed so largely to his political success, and give to the world his ideas on men and things in general. His words were not burdened with wisdom; indeed, they bordered so closely on the commonplace as to renew in our minds the wonder and humiliation of it all, that a political adventurer of such diminutive mentality should be so lording it over us, and growing fat upon the substance of the second greatest city in the world.

It was not surprising that the successful leader in a movement whose political methods have raised such a stench in the public nostrils should entirely misunderstand the lessons of the present remarkable developments in our industrial life; and he never made a more misleading statement than when he said that, owing to trusts and commercial combinations, the youth of the land no longer had a fair chance to earn a living. As a matter of fact one of the most striking features of our present industrial era is the remarkable prominence of the younger men; the splendid opportunities that are offered them, and the distinguished way in which they are carrying burdens of responsibilities, which in an earlier age were supposed to fall only upon much older shoulders.

The present is essentially—in America at least—the day of the young man. He is in demand. If he be mentally well-equipped, and have character and common sense to back his knowledge, he will find that there are opportunities open to him, often on the very threshold of his business career, such as the young man of an earlier day would dream of as the goal only of long years of waiting and working.

During a recent visit to that hive of industry which swarms around Pittsburg, and in the valleys of the Monongahela and Allegheny, we were impressed with the fact that in most of the great manufacturing establishments the highest positions of responsibility were filled by men who were yet several years on this side of the prime of life. That such young heads should so often be directing vast industrial concerns, is due in part to the amazing rapidity with which new industries have sprung up during the past decade, and in part to the fact that the keen competition of the age calls for the adaptiveness and energy which are the natural qualities of youth.

Time was when there was an overplus, especially in the technical trades and professions, of the supply of qualified young men; but to-day conditions are entirely reversed. Clear proof of this was shown at the recent annual commencement exercises of the Stevens Institute of Technology, Hoboken, when, out of forty graduates only a dozen were present to receive their diplomas. This unprecedented condition of things was explained by President Morton on the ground that the demand for graduates to fill business positions this year had been the most urgent in the history of the Institute, and that most of the absentees had been induced to leave the Institute a week or more before commencement, in order that they might begin their professional duties at once. President Morton further stated that the whole of the forty graduates could have secured positions at once if they had so desired. There is no gainsaying the significance of such facts as these; and as like conditions will produce like results, it is probable that, before many years have elapsed, these young graduates will have risen to positions which are both responsible and remunerative.

THE LEADING NAVIES OF THE WORLD COMPARED.

Comparisons of the relative strength of the leading navies of the world are in a measure unsatisfactory for the reason that any basis on which the comparison is instituted is necessarily more or less arbitrary. This is particularly true of comparisons based on tables showing the number of fighting ships of each class possessed by the navies compared. Great Britain, for instance, is credited with a total of thirty-eight first-class battleships as against a combined total of twenty-seven possessed by France and Russia, and the question is at once suggested: by what standard do we determine whether a battleship is of the first or some other class? Again, we may state that Great Britain possesses a total of fifty-nine battleships of all classes as against a total of fifty-nine battleships of all classes possessed by France and Russia; but here again we are confronted by the fact that some of the leading admirals and other experts of the British Navy are contending that many of the vessels which are ranked as third-class battleships in this estimate, are from twenty-five to thirty years old and are, therefore, too obsolete to rank in the active list of a navy of the year 1901; while, on the other hand, the oldest of the French third-class battleships have not seen more than twenty-six years of service, and, unlike the British vessels referred to, have been reconstructed and rearmed with modern weapons.

However, since some basis of comparison is necessary, we will take, in the present case, the comparative tables of the leading navies of the world as published in Brassey's Naval Annual. In looking them over, one is struck with the fact that a conscientious effort has been made to separate the fighting ships into such classes as agree with their ever-increasing age and ever-decreasing efficiency; and although one may consider that such old vessels as the "Sultan" and "Superb," which still carry muzzle-loading rifles as their main armament, might well be dropped from the list of active battleships in the British Navy, there is compensation in the fact that such powerful battleships as the "Nile" and the "Trafalgar," of 12,000 tons displacement and 16½ knots speed, carrying four 13½ inch breech-loading rifles as their main armament, should have been transferred from the first to the second-class in these tables. We notice that in pursuance of the same policy our own battleship "Texas" appears in this year's annual as a battleship, not of the second, but of the third-class.

Of effective fighting ships built and building, then, Great Britain has fifty-nine, France, thirty-four; Russia, twenty-five; Italy, sixteen; Germany, twenty-three; the United States, eighteen, and Japan seven. On this basis of comparison the United States stands fifth in the list. Although Germany possesses five battleships more than this country, when the battleships are segregated into classes, we find that the position of the United States is greatly improved, while Great Britain shows a very great preponderance over the navies of France and Russia combined. Of battleships of the first-class, Great Britain comes first with thirty-eight, and is followed by the United States with seventeen, Germany with sixteen, Russia with fourteen, and France and Italy with thirteen and nine, while Japan comes last with six. This is certainly a gratifying showing for the United States Navy—particularly so when we bear in mind that our battleships, and especially the eight vessels of the "Maine" and "New Jersey" classes, are the most powerfully armed, and among the largest battleships in the world.

The most recent battleship designs vary considerably in displacement, the smallest being the seven vessels of the "Wittelsbach" class, of the German Navy, which are of 11,800 tons displacement and 19 knots speed, while the largest are the 15,000 ton vessels of the "London" and "Queen" type, of the British Navy, and of the "New Jersey" and "Rhode Island" type, in our own navy. The most original of all the new battleship designs is the "Regina Elena," of the Italian Navy, a 12,624-ton vessel which is to carry two 12-inch, twelve 8-inch, and twelve 3-inch guns, and is to have a sea speed of 22 knots an hour. With her belt of 9¾-inch steel and a stowage capacity of 2,000 tons of fuel, this vessel is certainly the ideal representative of that battleship-cruiser type, to which we are inclined to think all future naval construction is tending.

Under the head of cruisers Great Britain is credited with 149 and France with fifty-five; while the United States comes third with thirty-four and is followed by Germany with thirty-one, Russian twenty-five, Japan twenty-two, and Italy with twenty-one cruisers. Considering only the first-class cruisers, Great Britain is seen again to have a long lead, with a total of forty-three vessels, ranging in displacement from 7,350 tons and 20 knots speed to 14,000 tons and 23 knots speed, while the United States is bracketed with Russia in the third position, each having thirteen first-class cruisers, France coming second with nineteen of this class. Cruisers of the first-class, particularly those which have lately been authorized, are all armored vessels, and, in fact, the unarmored cruiser seems to have passed almost entirely out of favor. Great Britain has now under construction fourteen armored vessels of 9,800 to 14,100 tons displacement, all of 23 knots sea speed, while our armored cruisers of the "California" type are about the same size as the 14,100 ton cruisers, but have one knot less speed. Against this, however, is to be offset the fact that the armament of our cruisers is somewhat heavier.

Under the head of coast-defense ships, we find that Germany heads the list with nineteen vessels, followed by Great Britain with seventeen, Russia, sixteen; France, fourteen; the United States, ten; Italy, three, and Japan, one vessel. Here again mere enumeration of units fails to give the United States its adequate position, since in some of the foreign countries the coast-defense vessels are a nondescript lot of old battleships and cruisers of somewhat doubtful utility, whereas our ten vessels include the new 4,000-ton monitors of the "Arkansas" class, which will be armed with a pair of the most powerful 12-inch guns in the world, and also the "Monterey," which may be called a thoroughly modern vessel. The United States do not figure in the comparison of the strength of the world's navies in what is known as torpedo gunboat class, our smaller vessels being of too large a displacement to be included under this head. Great Britain has thirty-four gunboats built and building; France, twenty-one; Italy, seventeen; Russia, nine; Germany, four, and Japan, two.

Summing up, it must be confessed that the comparison is a pleasing one judged from the standpoint of the United States; especially when we remember that it was not so very many years ago that our navy, in the modern sense of the term, did not exist. As matters now stand the United States and Germany appear to be of equal strength, considered numerically; but when we consider the offensive and defensive power of the battleships which we now have under construction, it must be admitted that, in spite of the large building programme which Germany now has in hand, the fighting strength of our navy to-day is, perhaps, on paper, a little stronger than that of Germany.

REPORT OF ROYAL BRITISH OBSERVATORY FOR 1900.

The report for 1900 of the Royal British Observatory at Greenwich has been issued. This observatory was founded in 1675 during the reign of Charles II., owing to the increase in the British maritime trade rendering the determination of longitude at sea absolutely necessary. The hill which the buildings now occupy was formerly the site of a castle owned by Humphrey, Duke of Gloucester, and the alterations were carried out by Sir Christopher Wren. When the Duke died the property reverted to the Crown, and the castle was then successively utilized as a royal residence, a prison, and a place of defense.

The director of the Observatory is officially known as the Astronomer Royal. He receives his appointment from the Prime Minister, although the Observatory is under the control of the Lords of the Admiralty. The present Astronomer Royal is Mr. Christie, who succeeded Sir George Airy twenty years ago.

During recent years the buildings have been considerably extended, and several new instruments have been added. The most important is the telescope designed by the Astronomer Royal and erected by Sir Howard Grubb. It is a most powerful telescope, as the tube is 28 feet in length, the objective 28 inches in diameter. Although a large instrument, it is so delicately adjusted that it can be moved by the hand to any part of the heavens. Another important instrument is the photographic telescope, presented by Sir Henry Thompson, and which is accommodated in a specially constructed building. In addition to the general daily and nightly observations of the heavens, exhaustive records are kept relating to the changes of the temperature, velocity of the wind, humidity of the atmosphere, the earth's magnetism, etc. All the chronometers used in the Royal Navy are examined and tested at the Observatory. Hourly and daily signals are sent to the various post offices throughout the United Kingdom, giving Greenwich time, while on the eastern turret an apparatus is placed by means of which captains of vessels passing up and down the Thames can ascertain the actual time.

Apprehension is being entertained that now that electricity is being so widely utilized throughout London for street transit purposes the magnetic instruments of the Observatory will be disturbed and incorrect records obtained. The London County Council have adopted a perfectly satisfactory insulated return, so that the magnetic registers will not be deranged, and it is hoped that the other companies will adopt similar measures. The French Magnetic Observatory at St. Maur is encountering similar difficulties, owing to the near approach of electric tramways to the Observatory, but M. Moureaux has discovered that copper dampers reduce the intensity of the vibrations by about one-tenth. According to the annual report, the planet Eros has been photographed with the Thompson refractor for the determination of the solar par-

allax. The new star in Perseus, first seen at Greenwich on February 25, has been photographed every night since when weather permitted. The Astronomer Royal, by means of the expedition which went to Ovar, Portugal, to observe the total eclipse of the sun on May 28, 1900, has obtained five large-scale photographs of the corona; four pairs small-scale photographs showing the extension of the corona; and two photographs of the corona spectrum. The first contact could not be seen at Greenwich owing to the presence of clouds, but during the clear intervals eleven observations were made with the new altazimuth.

THE BERLINER TRANSMITTER PATENT HELD TO BE INVALID.

On Monday, June 24, 1901, Judge Brown, representing the United States Circuit Court for the District of Massachusetts, handed down the full text of the opinion of that court in the two so-called Berliner telephone patent cases.

These cases were practically decided in February last, and an additional mention of a rescript of the court's opinion was made in the columns of the SCIENTIFIC AMERICAN of March 9, 1901. The complete opinion of the court, however, was not made public at that time.

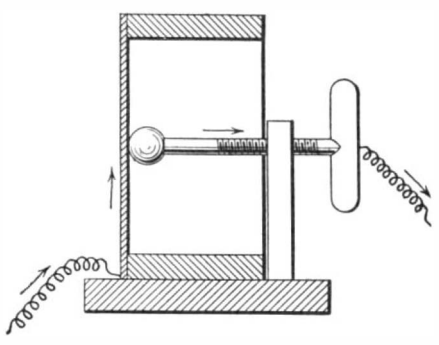
The two respective suits were brought by the American Bell Telephone Company in the form of bills in equity seeking to enjoin the National Telephone Manufacturing Company et al. and the Century Telephone Company et al. from infringing patent No. 463,569. As heretofore stated in these columns, the application for this patent was made by Emile Berliner on June 4, 1877, and was assigned to the Bell corporation the year following, but through the manipulations of the assignee's attorneys, the patent was not issued from the Patent Office until November 17, 1891. The logical effect of this delay was a tendency to prolong the monopoly of the Bell corporation, provided, of course, the patent was valid and could be given a broad interpretation in the courts.

In the suits in question the Bell corporation alleged the infringement of claims 1 and 2 of this patent, which are as follows:

"1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described.

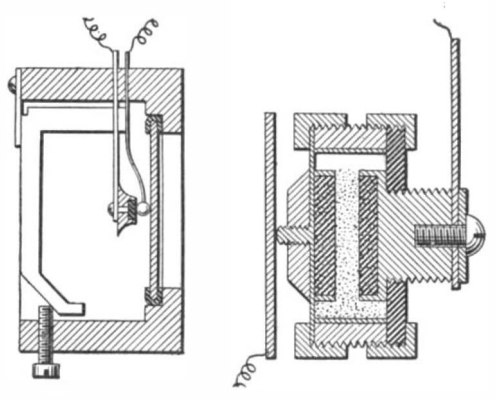
"2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate."

The structure shown in the patent and upon which these claims were based is represented in Fig. 1. The



current follows the path indicated by the arrows, passing from the metallic diaphragm to the metallic sphere in contact with the same. The screw serves to adjust the contact between the diaphragm and the sphere.

The transmitters used by the defendant corporations, and which were alleged by the complainant corporation



to infringe the structure above shown and defined in claims 1 and 2, are represented in Figs. 2 and 3. The structure shown in Fig. 2 is one form of the familiar Blake transmitter. A little sphere of platinum is located between the diaphragm and a button of hard carbon, which is mounted upon a spring, and is adjustable toward and from the diaphragm.

In the transmitter shown in Fig. 3 a loose carbon powder lies between two solid carbon plates, one of which is actuated by the diaphragm, so that movements of the latter cause the loose carbon particles to be alternately pressed together and released. The carbon plates are encased and mounted upon a leaf-spring.

The defendant corporations contended among other things that the patent was void, and for the following reasons, to wit:

First, the patent as finally issued represented a different structure from that which Berliner described in the application as originally filed.

Second, that Edison and not Berliner was the inventor of the subject matter finally patented.

Third, that the structure which Berliner originally described in his application was old at the time the application was filed; and

Fourth, that a former patent issued to Berliner had disclosed his structure, and therefore the Patent Office had no power to issue another patent to him upon the same structure.

The merits of the case were argued at great length pro and con by distinguished counsel. The famous transmitter invented in Germany by Reis, several transmitters of Mr. Edison, and Bell's so-called liquid transmitter were brought into discussion, the question being whether these devices anticipated Berliner's structure and patent. Much expert testimony was taken.

One important question presented by the suits was whether a metallic sphere adjustable against the vibratory diaphragm and claimed broadly could anticipate the well-known carbon transmitter. The peculiar properties of carbon for this purpose were apparently unknown to Berliner or anybody else at the time the application was originally filed. In other words, it was a question whether a metallic contact in a transmitter, broadly claimed, could anticipate a carbon contact of variable resistance, the variable-resistance property of the carbon being unknown at the time of the application.

Referring to the anticipatory effect of Bell's liquid transmitter, the patent for which had formerly belonged to the complainant corporation but had expired, so that the public had a right to use the invention, the court significantly remarked:

"The attempt to dispose of that apparatus by characterizing it as a mere laboratory experiment, after . . . it was presented to the Supreme Court as a speaking telephone (126 U. S., 247 to 322) is not successful. This instrument is quite as important after the expiration of Bell's patent as it was before."

Upon the subject of the difference in scope between the patent in suit and the original application therefor as filed in the Patent Office by Berliner, the court said:

"I am of the opinion that the language of these claims is clear and that no resort to the specifications is necessary to explain its meaning. They are not claims made in the infancy of an art by an unskilled inventor. They were put in the present form more than two years after Edison's carbon telephone had been placed on the market."

Discussing the changes alleged to have been made in the structure and action of the apparatus after the original application had been filed and before the patent was issued, the court observed:

"The patent calls for constant contact of electrodes and an unbroken current; the application, for an interrupted contact and a broken current. The Supreme Court has decided that these methods are radically distinct. (126 U. S., 544 to 545)."

The learned judge summed up the opinion of the court in the following language:

"I am, therefore, of the opinion that even if the complainant were able to prove that Berliner had in fact made an invention; that his application upon its face disclosed this invention; that he was lawfully entitled to make the amendments; and that his previous patent of 1880 did not exhaust the power of the Commissioner to grant the patent in suit, and that he was not anticipated by Edison; that, even after all this, well-established rules of law would require us to hold that claim 1 of this patent is void, and that claim 2 is either void or so limited that it does not include the defendants' transmitters.

"It has been impossible, in this opinion, to consider all the points of the very able arguments that have been presented, or all the important contentions that have arisen. The brief of the defendants has met the case of the complainant thoroughly and completely, and with very exceptional ability and commendable fairness has demonstrated, in my opinion, that the complainant's case rests upon a patent that should not have been granted, and which is void for error apparent upon the face of the records of the Patent Office; that as a matter of fact Berliner on June 4, 1877, the date of his application, had not made the discovery that speech could be transmitted with the apparatus of the patent in suit, and was at that time, and long after, like other unsuccessful experimenters, attempting to use a broken current. In addition to the fundamental defects in the complainant's title to the patent, it appears that the best argument that skilled experts and learned and ingenious counsel can base upon this patent is logically untenable and legally unsound.

"The bills will be dismissed."

PARIS-BERLIN AUTOMOBILE RACE.

Racing automobiles were never put to a more severe test than in the Paris-Berlin race. The machines started on June 28 from Champigny, a suburb of Paris, and finished their trip June 29, at Berlin. M. Fourrier, with a Mors carriage, covered the 750 miles in record time. A crowd of 2,000 persons witnessed the start. One firm of automobile builders had a staff of seventy-seven mechanics on the ground to inspect their machines before leaving. The route was by Aix-la-Chapelle and Hanover. M. Fournier was the first to arrive at the former place. He stated that the crowds which lined the road during the last 40 miles were so great that he constantly feared there would be a fatal accident. M. Fournier's actual racing time for the 282½ miles was 6 hours and 58 minutes, road-rules compelling him to slow down in many towns and villages. The next day's trip was from Aix-la-Chapelle to Hanover, a distance of 275 miles. M. Fournier was again the first to arrive at the end of the second stage of the race. His time was 9 hours 7 minutes and 39 seconds. Many of the drivers of the automobiles were so exhausted and nerve-shaken at the end of their second day's trip that they could hardly speak. The bad condition of the roads and the hot sun which affected the tires, prevented any very phenomenal speed. There were a number of accidents on both days' runs. The third stage from Hanover to Berlin, 297 miles, was made in 11 hours, 46 minutes and 10 seconds. M. Giradot, on a Panhard machine, finished second in 12 hours, 15 minutes and 40 seconds; M. Brasier was third. The reception of the riders by the Germans at Berlin was an ovation.

SCIENCE NOTES.

Dr. Vaughan Cornish, F. G. S., gave an interesting lecture at the London Geographical Society concerning waves, illustrated with photographs which he had secured during his investigations. Regarding ocean waves and the enormous heights they are generally supposed to attain, Dr. Cornish stated that the average height of waves in mid-ocean was 18 feet, though waves 30 feet in height were by no means uncommon. During a recent storm in the North Atlantic, however, the lecturer had measured some of the waves and found that they attained the extraordinary height of 40 feet.

Sir Norman Lockyer, the eminent English astronomer, resigns his position as Professor of Astronomical Physics at the Royal College of Science, South Kensington, London, at the end of the present year. He has been connected with the Department of Science and Art for twenty-six years. Between the years 1870 and 1900 he was the chief of seven eclipse expeditions, and his volume "Recent and Coming Eclipses," based upon his investigations during those thirty years, is a valuable addition to scientific literature. Sir Norman Lockyer, however, proposes to retain his position as Director of Solar Physics at the South Kensington Observatory.

The farmers in South Lincolnshire (England) have been suffering from a plague of insects called the mustard bug, which devours the white mustard crops. Several farmers have had acres of valuable crops destroyed by this pest, and have been unable to discover an efficacious remedy. They have now resolved upon a curious expedient. Flocks of chickens are turned into the white mustard fields, and since the bug is somewhat of a delicacy to the fowl, it is anticipated that the pest will be overcome and that the crops so far untouched will be saved.

The first sealed thermometer was made some time prior to 1654 by Ferdinand II., Grand Duke of Tuscany; he filled the bulb and part of the tube with alcohol, and then sealed the tube by melting the glass tip, says The Engineer. There appears to be considerable doubt as to who first employed mercury as the thermometric liquid; the Academia del Cimento used such an instrument in 1657, and they were known in Paris in 1659. Fahrenheit, however, appears to have been the first to construct, in 1714, mercury thermometers having trustworthy scales. The use of the boiling point of water as the upper fixed point was suggested by Carlo Renaldini in 1694.

DEATH OF PROF. JOHN FISKE.

Professor John Fiske, of Cambridge, the historian and philosopher, died from the effects of the heat on July 4th. He was born in Hartford, Conn., March 30, 1842. As a boy he was extremely precocious; he began the study of Latin when only six years old, and at seven he was reading Cæsar. In 1860 he entered the Sophomore class of Harvard and finally became a lawyer. He did not practise law to any extent, but commenced to write for magazines and reviews. In the scientific world he was regarded as a specially able expounder of the philosophy of Herbert Spencer and the theory of evolution. His scientific writings were considerable.

ZINC MINING IN KANSAS.

BY HARRY L. WOHLFORD.

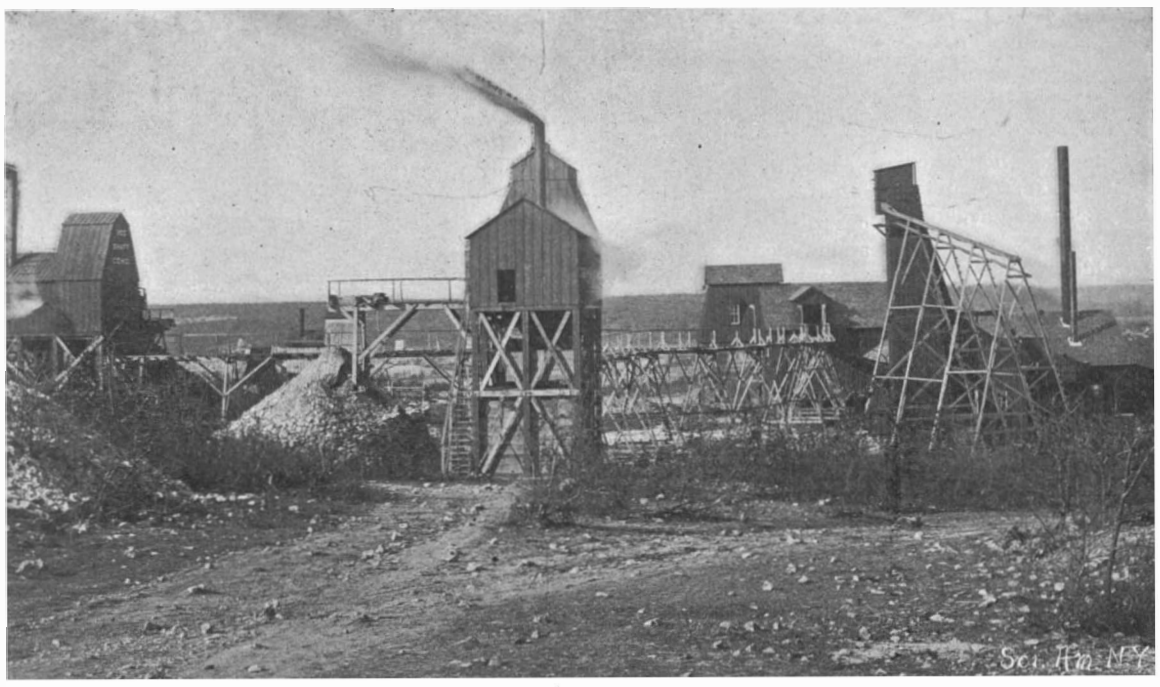
From a small triangular area in southeastern Kansas—perhaps six miles wide at its base and ten miles high along its side—there have been mined, during a period of twenty-four years, lead and zinc ores to the value of more than thirty million dollars. The entire region presents a most curious aspect to the mining man from further west. On the surface may be seen the farmer busy with his grain or among his stock, while beneath him fifty, a hundred, and sometimes two hundred feet, the miners are toiling with pick and drill and blast. The discovery of mineral was made here in April, 1876, and since that date the productiveness of the mines and the working of them have continued unabated.

The galena, or lead ore, is the ordinary lead sulphide (PbS). It is a dark bluish black in color and is usually found in the form of cubes, varying in size from a pinhead to blocks six and eight inches across their face. There are also found here two, and in some localities three zinc ores, though the most important one is the common zinc sulphide (ZnS), containing about 67 per cent metallic zinc. When first brought to the surface its colors are widely diversified, many blocks forming the most beautiful specimens imaginable. Some retain their brilliancy indefinitely, others again lose their bright hues after a short exposure to the atmosphere. The miners have coined names for these multicolored ores, and they are known respectively as "rosin jack," "gray jack," "black jack," "peacock jack," etc., the last-named possessing colors with which the rainbow can scarcely vie.

Together with the lead and zinc ores are found a number of secondary ores and minerals. One of these is a double sulphide of iron, or "mundi," as the miners term it, having a specific gravity of 4.95. Its admixture with clean zinc is closely guarded against, as a small per cent of this impurity greatly affects the marketable value of the clean ore. Perhaps the most abundant of all the associate minerals is a calcium carbonate known locally as "tiff." It assumes various forms, though the most common one is crystalline. Some of the pieces taken from the ground are ravishingly beautiful, with their clustered crystals flashing in the sunlight and their translucent whiteness in sharp contrast against the somber colored blocks of lead. Aside from the ones mentioned there are yet other adulterants found in connection with the lead and zinc ores. One of these is a barium sulphate ($BaSO_4$), the other a calcium fluoride ($CaFl_2$), though neither occurs throughout this district to any considerable extent.

The early history of the Short Creek district is one of crude methods, scanty results and illogical deductions. The mines were little else than surface prospecting, and the general opinion among the miners was that the ore deposits were of a superficial character and that no lower-lying bodies of ore existed. Since then strongly capitalized companies have taken in charge many tracts of land, deemed practically exhausted, and by means of huge centrifugal pumps have so thoroughly drained the ground that now deeper prospecting is found to be not only possible, but lucrative as well. Positive proof is shown by these deeper operations that greater bodies of ore lie below than above the hundred-foot level. The most rudimentary methods were employed by the early-day prospectors. A hoister-crane, dangerously weak-looking, with an ox or a slow-moving horse for motive power, a half barrel for a tub, and a sluice-box planted in the nearest stream, is a general description of the average prospecting outfit. Now steam has taken the horse's place and the hoister sweeps and great iron tubs have forced the half barrels into the rubbish heap.

But of all the changes made, perhaps the most radical one was in the method of washing the ore-bearing earth. The sluice-box gave place to an affair known as a "jig tank," a large square box filled with water in which was suspended from uprights fastened at either



A TYPICAL KANSAS ZINC-ORE REDUCING MILL.

side an oblong trough, whose flat bottom was formed of iron bars. The interstices between the bars permitted the water in the larger box to pass upward through the wash-dirt in the trough, as it was raised and lowered by means of a long pole attached to a crosspiece above it. The wash of the water between the bars causes the ore, being the heaviest, to sink to the bottom of the trough, so that the flint and other waste might be shoveled from the top.

The crushers or mills throughout the district are capable of crushing and cleaning, during a shift of ten hours, from fifty to one hundred tons of ore-bearing rock at a cost ranging from ten to fourteen dollars per ton, much depending on the richness of the dirt and the facilities for rapid handling. The cost of one of these monsters is quite an item. Nothing worthy the name, even, can be erected for less than five thousand dollars, while many reach an approximate cost of from ten to twelve thousand.

There are now in the district more than a hundred mills, the greater part of them having been erected during the years 1899 and 1900.

Very little mining land is sold, the owner generally preferring to lease the ground on a royalty to some person or company who in turn sublet it to the actual miner. The second lessee collects a royalty of 20 per cent from the miner, 10 per cent of which he in turn is assessed by the land owner.

All ore is weighed upon the company's scales, and it is to them and not to the actual owner of the ore that the buyer makes the check.

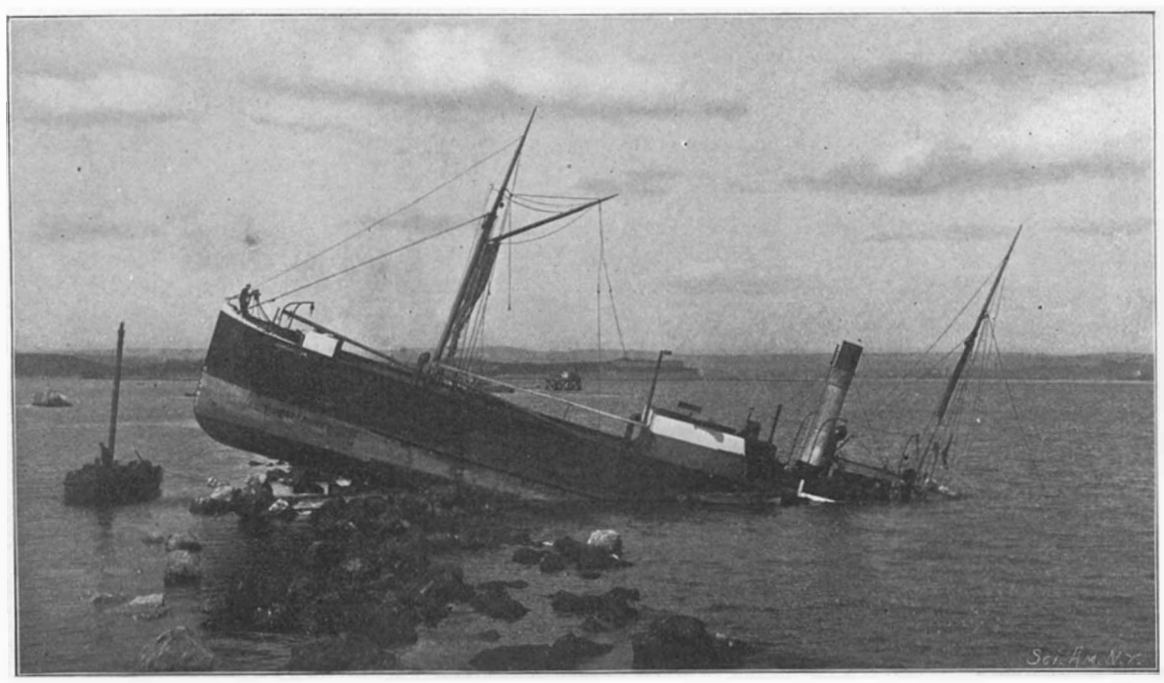
Ore intended for shipment to foreign markets is sacked, so that the handling of it is greatly facilitated, and the waste during transit reduced to the minimum.

Antwerp in Belgium is progressing rapidly to the front as a consumer of American zinc. At present writing there has been pledged, by the producers in the Kansas zinc fields and the adjacent district in Missouri, more than a thousand tons weekly to the firm of J. Needham's Sons, of Antwerp. The through shipping rate will be less than six dollars per ton to land the ore in that city. It is fully believed by all the producers and operators in the two districts that this immense foreign market will very effectually regulate the price of zinc ore in the United States.

Mine ownership here is well distributed among the laboring class, and universal satisfaction and good will is always maintained. The fact that the mines have been operated since their discovery without a strike or labor trouble of any kind is ample proof of the feasibility of the system.

A CLEVER SALVAGE FEAT

We publish herewith a photograph relating to a unique salvage feat that has recently been accomplished in England. During the night of March 25 last, the steamship "Dinnington," while trying to make Portland Harbor during a heavy gale, was wrecked upon the outer arm of the new breakwater that is being constructed at Portland for the British Admiralty. The captain of the vessel missed the entrance and ran upon the rocks at full speed. It was high tide at the time, and a heavy southeasterly sea was running. The contractors for this breakwater have only just completed the submerged portion of the work, so that at high tide the structure is covered. A comprehensive idea of the speed at which the vessel was traveling at the time of the disaster may be gathered from the fact that she nearly jumped over the breakwater. There could not have been more than two feet of water covering the rocks at the time. The ship was caught by the rocks right amidships, and at low tide she was in the perilous position shown in our photograph. Four tugs were dispatched to her assistance, since it was thought that the damage to her hull was purely superficial, and that she could easily be hauled off. The combined power of these tugs, however, failed to move her, and closer examination proved that a sharp rock had penetrated her bottom amidships and she was jammed upon this as if fixed upon a pivot. The action of the waves severely bumped her upon the rocks, with the result that several other holes were soon torn in her sides, and she rapidly filled with water. After several attempts to salvage her she was abandoned by the underwriters, and it was proposed to destroy her.



S. S. "DINNINGTON" WRECKED ON PORTLAND BREAKWATER—AFTER END OF VESSEL LYING IN 54 FEET OF WATER.

At this juncture, the West of England Salvage Company of Penzance offered to recover the wreck. The work was pursued under the superintendence of Capt. W. E. Anderson, the officer engaged by the American government to report upon the disaster to the battleship "Maine." The task was beset with innumerable difficulties. The wreck was fully exposed to the fury of the southeasterly gales, which at that time of the year were raging furiously. On two occasions he had completed his arrangements for towing her off the rocks, but each time had to abandon the work on account of the gales springing up and destroying all his plans.

There was another danger. The constant bumping of the vessel by the motion of the waves was knocking her bottom all to pieces, and she threatened to slip off the rock that was holding her securely. There was a depth of 54 feet of water at the stern, but fortunately the weight of this was counterbalanced by a

heavy cargo which was stowed in her forward holds. By this means she was evenly balanced.

When the weather was once more propitious, Capt. Anderson hurried forward the arrangements for his next attempt to float her. He constructed a coffer dam six feet in diameter round the after end of the ship, and requisitioned the assistance of several powerful centrifugal pumps, the aggregate pumping capacity of which was 1,100 tons per hour. By this means the water in the after part of the wreck was soon removed, and with the aid of five powerful tugs he had the satisfaction of hauling her into deep water once more. The "Dennington" was towed into Portland Harbor, where she was temporarily patched up. She was then taken to Southampton by the salvage steamer "Greencastle."

ARTESIAN WELL THAT DISCHARGES 11,158 GALLONS DAILY. DEPTH OF WELL, 1,303 FEET.

ARTESIAN WELL AT BEAVER CROSSING, NEB.—NINE SUCH WELLS MAKE IT POSSIBLE TO IRRIGATE 115 ACRES.

A FEW REMARKABLE ARTESIAN WELLS AND THE USES TO WHICH THEY ARE PUT.

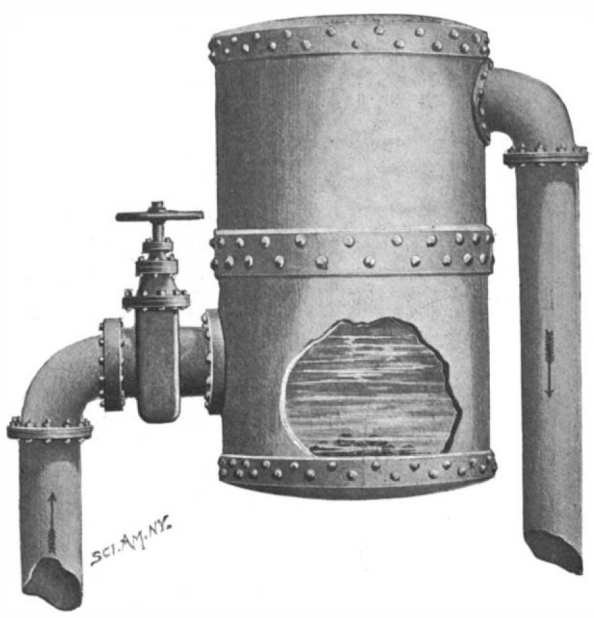
BY ERWIN HINCKLEY BARBOUR.

The traveler in eastern South Dakota and Nebraska is always duly impressed by the powerful flowing wells met with throughout this magnificent area. The conditions here seem to be favorable for artesian water, and wherever the general level is reduced by such rivers as the James and the Missouri, gushing wells seem a certainty, if drilled to a depth varying from 500 to 1,000 feet or more. The shales and limestones of the Carboniferous period form an underlying, impermeable stratum throughout this region. Upon these there rests a bed of 300 to 400 feet of very permeable sand of the Dakota Cretaceous. These are the finest water-bearing beds of the plains, and they are cased in above, even more effectually than below, by 1,000 to 2,000 feet of water-tight Cretaceous shale (chiefly Pierre) and bad-land clays (Oligocene). The beds are so tipped that there is a difference of several thousand feet between the eastern edge, where the great fountains occur, and the western edge, or the fountain head.

In the Rocky Mountain uplift, of which the Black Hills is but the most eastern spur, the western edge is thrust upward to an elevation of 5,000 to 6,000 feet higher than the eastern edge. The upturned edges of all of these beds are exposed along the eastern flank of the Rocky Mountains, ready to catch the falling rains, melting snows, and the mountain streams. On the lower levels, then, where this water bearing Cretaceous is struck, flowing wells are so certain that to bore for water seems like tapping a water main.

When there is no friction or leakage the head would be equivalent to that of a column of water several thousand feet high. Hence, in spite of mechanical losses due to friction, etc., and to the natural escape of the water through leakage, a high pressure is to be expected, and is fully realized, in the great wells, which discharge large volumes of water, and even suffice to run mills and machinery. As an example of the artesian well serving as an engine of some economic importance, a better instance could not be cited, perhaps, than that of the well at Niobrara, in Knox County, Nebraska, which, in addition to the work of pumping water and running the dynamos for the town, also drives the machinery of a 60-barrel flour mill.

The water flows through a 6-inch casing into a unique device called the "stone-catcher," the object



STEEL STONE-CATCHER AT THE HEAD OF ARTESIAN WELL.

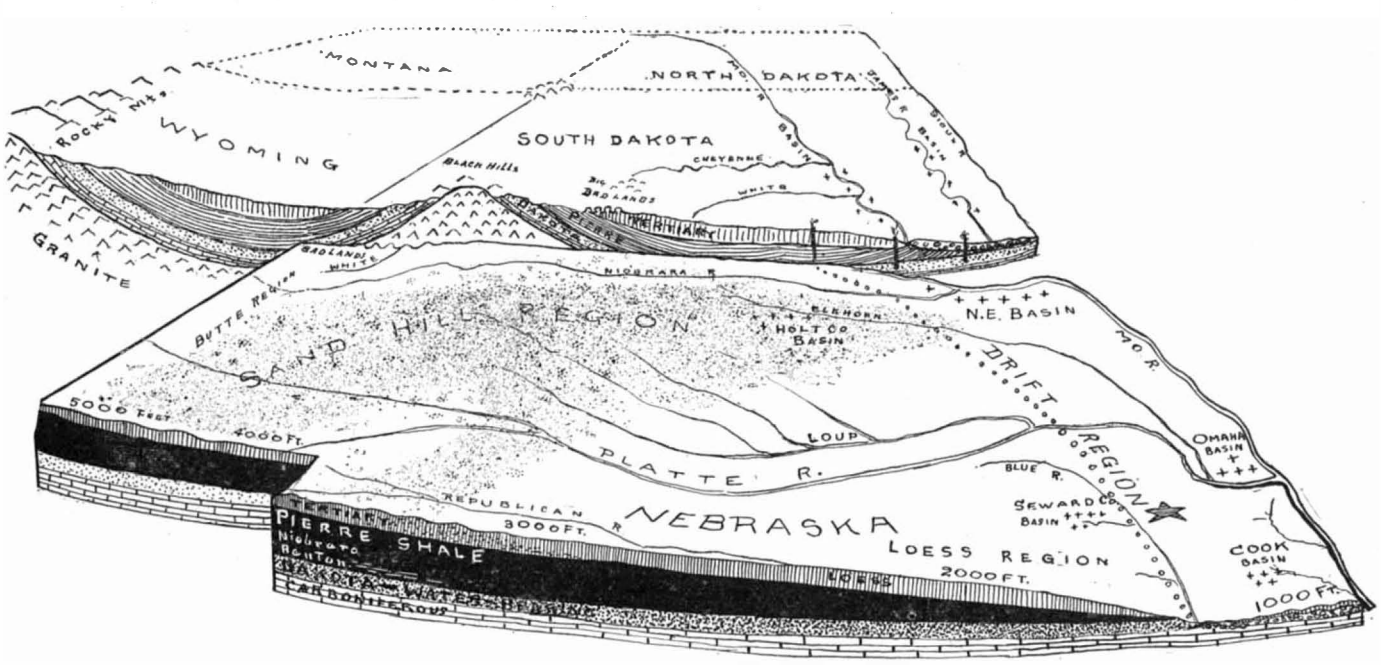
of which is to arrest pebbles, small bowlders, and stones, which are shot out with sufficient force to damage the steel casing and machinery. One such pebble, weighing 22½ pounds, is still preserved in Niobrara. From the stone-catcher the water is conducted to the mill, where it strikes the fans of a 4-foot Pelton wheel through a one and one-half inch nozzle.

It works perfectly, steadily, silently, and with no coal or ash to shovel, no engineer and stoker to pay. And, after first costs are met, it can be depended on for years of steady service without involving any additional outlay. In the event of fire, the full energy of the well is turned at the first alarm into the city mains, and the linemen with hose have instant command of the situation.

Modern cities, boasting of the most approved systems, offer no better protection from fire than does this small Western town. At night the same water runs the dynamo and lights the place, besides filling the public reservoir—all of which seems like getting a great deal for nothing. After the energy of the water is expended on the Pelton wheel, it flows through a wasteway into a lakelet, and thence finds it way for three miles by a creditable little stream to the Niobrara River. A city might be founded on such a natural resource, for it seems assured that every wheel could be turned by this subterranean store of energy, which can be tapped indefinitely, and over many square miles of country.

Hundreds of these artesian wells are daily put to all sorts of commonplace uses, while here and there we find one engaged in work of a novel kind. One of these is the artesian irrigating plant on the Furgusson farm at Beaver Crossing, Seward County, Nebraska, where nine shallow artesian wells, none of them over 100 feet deep, make it possible to water 115 acres on short notice. The worse the drought, the better for the owner of such a farm.

The great Test Well at Lincoln, 2,463 feet deep, helps to supply water to Salt Lake, while the two wells at the Sulpho-Saline Baths of Lincoln supply water for the great natatorium of that institution. In Omaha a series of artesian wells add greatly to the beauty of various parks, by supplying fountains, streams, pools and lakes, the largest of which, seen on the Miller estate, covers some thirty acres. But of all the utilization of artesian water the most highly commendable and original seems to be that at Pierre, South Dakota, where three great wells perform the singular work of supplying water, natural gas, and electricity for the town. The discharge comes to the surface as water, but, paradoxically enough, goes to the consumer as natural gas and electricity. Taking advantage of the discovery made shortly after the completion of the wells, that with the lowering of the pressure as the water escapes natural gas is liberated, the wells were piped into suitable retaining tanks and a sufficient quantity of natural gas was thus accumulated to supply the town and run the engines of the electric light plants as well as those of a 60 horse power pumping station.



MAP DESIGNED TO SHOW THE RELATION OF THE BEDS TO THE ARTESIAN REGIONS IN NEBRASKA AND SOUTH DAKOTA.

The sandstone of the Dakota Cretaceous, some 300 feet in thickness, is encased below by Carboniferous limestones and shales, and above by shales chiefly of the Pierre. All beds dip downward from the mountains to the east, where the artesian regions occur.

ADMIRABLE WORK OF THE ORDNANCE BOARD AT SANDY HOOK.

In a recent number of the SCIENTIFIC AMERICAN, we gave an account of the final tests of maximite, the new high explosive invented by Hudson Maxim, which completes the series which resulted in the final adoption of this compound by the United States government.

General A. R. Buffington, the Chief of the Bureau of Ordnance, undertook the thorough investigation of the subject of high explosives nearly three years ago, and accordingly the Ordnance Board, with headquarters at Sandy Hook Proving Ground, New Jersey, were assigned this duty. The board is composed of some of the ablest engineers and scientific men among the officers of the United States army, and men admirably adapted to this work. The members of the Board are Major Rogers Birnie, president; Capt. William Crozier, well known as one of the inventors of the Buffington-Crozier disappearing gun mount; Capt. O. B. Mitcham, inspector of explosives; Capt. B. W. Dunn, government expert on fuses and high explosives at Frankford Arsenal, and inventor of a new shrapnel which outclasses anything before done in this line, also inventor of the new government detonating fuse used with such successful results in the recent high explosive tests at Sandy Hook; and Capt. E. B. Babbitt, commanding officer at Sandy Hook.

It was determined to thoroughly investigate the subject of high explosives, including well-known explosive compounds, as well as any new explosive compounds which might be submitted by different inventors and manufacturers, provided the latter appeared to offer sufficient merit to warrant investigation.

It was determined to prosecute this work unceasingly, until the best compound that science could produce should be obtained for the service. At the beginning of these tests, had the board outlined what it would have considered an ideal explosive as a bursting charge for projectiles, the requirements would, we imagine, have been about as follows: Perfect chemical stability or keeping qualities; very great explosive power, high specific gravity, giving it as much force as possible per unit of volume; great insensitiveness, so great as to make it incapable of detonation from shock, rendering it not only safe for projection from guns at high velocities, but capable of withstanding the far greater shock of penetration of armor plate as thick as the strongest armor-piercing projectiles themselves can pass through. It should be comparatively inexpensive to manufacture. It should be capable of being melted at a comparatively low temperature, and it should be incapable of explosion from ignition, enabling it to be melted over an open fire, as occasion might require, and without any danger, for filling projectiles. It should be incapable of detonation from overheating, but should boil away like water on the rise of temperature beyond a certain point. It should solidify in the projectiles, forming a dense and solid mass, incapable of shifting even on striking armor-plate. Such we imagine to be about as high a standard of excellence for a high explosive as the most sanguine could have hoped for. From what we have learned of maximite, in light of the recent tests, it appears to possess all these qualities in a high degree, and the United States government is to be congratulated upon the efficient manner in which these tests have been conducted, resulting in the obtainment for the service of such a valuable high explosive.

The experiments were conducted with the utmost impartiality from first to last, and a very large number of different explosive compounds have been submitted for these trials. The first of note was what is known as thorite, a compound of nitrate of ammonia and a hydrocarbon combustible element, such as coal tar or asphalt. This explosive was submitted by Dr. Tuttle, of Seattle, Wash., and is a modification of the class of nitrate of ammonia compounds. Nitrate of ammonia, being an oxidizing salt relatively poor in oxygen, requires an admixture of only about 12 per cent of a hydrocarbon combustible to produce the best results. As nitrate of ammonia is a salt without a metallic base, it is resolvable completely into gaseous products. Consequently, such a mixture forms a powerful explosive and one, furthermore, which is very insensitive to shock. Nitrate of ammonia being exceedingly hygroscopic, the hydrocarbon combustible is generally melted and the nitrate of ammonia stirred into it, whereupon the nitrate of ammonia, in taking up the liquid, becomes coated or varnished with the hydrocarbon, protecting it to some extent from the moisture of the air. When a very hard hydrocarbon, such as asphalt, is used, it is first dissolved, as, for example, by heating with a small percentage of kerosene oil, coal tar, or vaseline, just enough to render the asphalt soluble in an excess of a lighter hydrocarbon, which, afterward being evaporated from the compound, leaves the particles of nitrate of ammonia coated with the somewhat hard hydrocarbon. The hydrocarbon, however, does not efficiently protect the explosive from the absorption of moisture, and it has to be kept in hermetically sealed vessels. Otherwise the atmospheric moisture will cause the liquefaction of the nitrate of ammonia, and render the explosive inert. Thorite is one such explosive compound, and during the early tests of this material at Sandy Hook the results were considered quite satisfactory. It gave fairly good fragmentation of the shell, and could be fired from guns with perfect safety with full pressures and velocities. Thorite would not, however, stand the shock of penetration of thick armor plate, because, being in granular form, it packed forward in the projectile with such violence that it would go off when fired through a comparatively thick plate; and when fired through a plate of moderate thickness, it packed

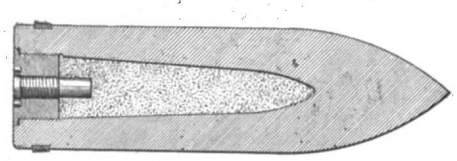


Fig. 1.—12-INCH ARMOR-PIERCING SHELL; 23 POUNDS HIGH EXPLOSIVE.

forward so much as to carry it beyond the reach of the fuse, and it could not be detonated.

Tests were then made by filling the shells with thorite under hydraulic pressure, but it was found that when the explosive was made dense enough to prevent packing forward in the shell on striking the plate, it became so hard and insensitive that it could not be detonated by any means whatever.

Further tests developed the fact that its hygroscopic character alone was so serious a drawback as to render its use as a service high explosive out of the question. Furthermore, it was found to be very erosive in its effect upon the projectile and fuse stock, after it had stood any considerable length of time, and vessels containing it were found to be eaten through by this erosive action. The use of thorite was, therefore, abandoned by the Ordnance Department.

Rendrock is another explosive which has given very good results and has proved altogether far superior to thorite. A high explosive developed by the War Department has given still higher results, and ranks

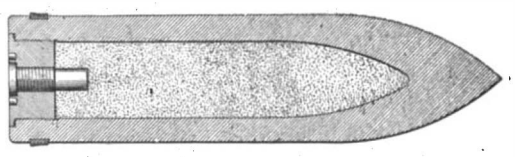


Fig. 2.—12-INCH ARMOR-PIERCING SHELL; 70 POUNDS OF HIGH EXPLOSIVE.

very high, being far superior to anything else which has been tried during these tests, except maximite, by which it is alone excelled. Had not maximite been invented, the government would have an explosive of its own production far superior to anything which has been developed abroad.

We give three illustrations, showing longitudinal central sections of the three principal forged steel 12-inch armor-piercing projectiles now used in the service.

Fig. 1 is the 12-inch armor-piercing shot, showing the construction and the strength of tempered forged steel necessary to penetrate Harveyized nickel-steel armor 12 inches in thickness. This projectile carries 23 pounds of maximite.

Fig. 2 is a 12-inch forged-steel armor-piercing projectile, showing the strength of metal necessary to the penetration of Harveyized nickel plate 7 inches in thickness. This shell carries 70 pounds of maximite.

Fig. 3 is the 12-inch torpedo shell, chiefly designed

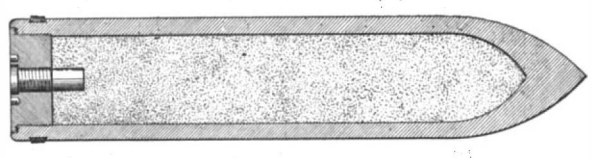


Fig. 3.—12-INCH TORPEDO SHELL; 144 POUNDS OF HIGH EXPLOSIVE.

for use in mortars, and shows the thickness of the metal necessary to penetrate 4 inches of deck armor. This projectile carries 144 pounds of maximite, the column of maximite being 4 feet in length, but so insensitive as not to require transverse partitions.

Portable storage batteries have been provided by the Brooklyn Rapid Transit Company, some of their old cars being utilized. Seven of the old Brighton Beach steam road cars were converted into a moving storage battery sub-station of 248 cells. In the summer, says the Street Railway Journal, they are located at Sheepshead Bay to supply the Brighton Beach cars with current. In the winter they are removed to East New York to double the capacity of the storage battery plant at that place.

Electrical Notes.

The electric tramways in London are proving a great success. So far only about 7½ miles of roads are in operation, and the conversion of the remainder of the old horse tramroad and the construction of the extensions are being rapidly pushed forward. On the section already in operation the cars carried 5,480,208 passengers in ten weeks. The average per day, estimating 70 days, with 60 cars, was 1,200 per car. The company estimates carrying 52,000,000 passengers per annum, and when the whole of the system is completed they expect the number to be increased to 120,000,000 per year. Of the total number of passengers carried within the ten weeks, over 100,000 represented working men who had been carried at the rate of half-a-cent per mile. The tramway extends to historic Hampton Court, and the favorite riverside resorts of Kingston, Kew, Teddington, and Molesey, all of which places are thronged during the season, especially on Sundays.

The town of Davos, in Switzerland, the center of the great tobogganning contests, proposes to dispense with fuel of all description and to resort to electricity for all industrial and domestic purposes. The project is to erect an extensive electrical generating plant at the confluence of two large mountain torrents. A prominent firm of Swiss electrical engineers has been studying closely the possibility of the scheme for several months, and now state that they are in a position to undertake the work. The firm has obtained the necessary permission to utilize the torrents for this purpose. The cost of the first installation, it is estimated, will be $1,700,000. Already electricity is extensively employed for cooking, heating and lighting in several villas, while one of the largest bakeries in the district is electrically equipped in every respect. The company which proposes to carry out the plans has already designed special electric heating and cooking appliances.

The success that has attended the laying of the subterranean telegraph cable between London and Birmingham, a distance of 113 miles, has prompted the postal authorities to utilize the cable for telephoning. This is considered to mark the limit of underground telephoning with the existing apparatus. Several of the other leading provincial towns, such as Liverpool, have petitioned the postal authorities to connect their cities with London by a direct subterranean cable, such as that running to Birmingham, but their requests have been refused until a method of transmitting underground telephonic messages over long distances is found. The British Post Office is gradually providing a reliable telephone system throughout the whole of the United Kingdom by the aid of the telegraph wires. For this purpose $10,000,000 has been authorized by Parliament, a large portion of which sum, however, is being expended upon the London telephone system, which it is expected will be partly in operation in the autumn of this year. The competition between the government and municipal telephone systems on the one side, and the National Telephone Company, which has hitherto enjoyed a monopoly, on the other side, is very keen. One town in the south of England, the first to possess a municipal telephone, has been the means of reducing the charge of the private company from $50 to $20 per annum.

The British Parliament is at present busily engaged in investigating the various underground electric railway schemes that have been projected in all directions of the metropolis since the Central London Electric Railway was opened. It is doubtful, however, whether any of the schemes for new railroads will be sanctioned this session, owing to the trouble that has been experienced in connection with the vibration caused by the Central London Railway. A committee of engineering experts, under the chairmanship of Lord Rayleigh, is at present investigating these complaints, and if they are found substantial the committee will recommend means by which the vibration might be overcome. The only scheme that will possibly receive official sanction is the conversion of the underground railway to electricity. The majority of the objections to the project have been surmounted, and, directly the consent is given, the work of conversion will be carried out with all possible speed. Sir Alexander Binnie, the eminent engineer to the London County Council, gave valuable evidence upon the subject of subterranean rapid transit before the committee and advanced several facts concerning the construction and working of the systems. He advocated the running of frequent trains at a high velocity, and at the same time contended that to insure such a satisfactory system each line would have to be worked independently upon the shuttle system, without any interferences from junctions, but that transfers of passengers should be made at different points where the railroads would cross, or run in close proximity to each other. He warmly approved those lines which promised to open up the suburbs, especially the Hampstead and Charing Cross Railway which Mr. Yerkes is going to construct. Altogether the value of the projected lines before Parliament this session aggregates $243,210,000, and the cost per mile will vary from $2,000,000 to $3,000,000.

INTERESTING EXHIBITS AT THE PAN-AMERICAN.

The Gruson Iron Works have erected in the space between the two Ordnance Buildings a full-sized model of the Gruson coast defense turret with two 12-inch guns, and for the first time the construction of such a turret is shown to the general public. Inside of one of the buildings there is also a model of a smaller turret, surrounded by photographs showing turrets in different stages of completion. The full-sized model is intended to show the actual size of the turret, the available space inside the thickness of the armor-plate and the general disposition of the guns, gun-carriage and machinery necessary for rotating the turret, elevating and depressing the guns, moving the ammunition, charging the rifles and checking their recoil. The model is open on one side. A number of the armor-plate sectors are left off so that the public can look into the interior, and outside the cross-section of the armor of the rotating cupola is shown, as well as the fixed, outer belt, the former protecting the guns and their service, the latter protecting the substructure and the machinery below. A model of one of the two 12-inch coast defense rifles is in place on its carriage and reaches through the right-hand embrasure or porthole into the open, while the left-hand embrasure is shown in one-half, presenting its cross-section to view. At the rear of the gun is seen the hoisting apparatus and the rammer. Under the gun is the carriage on its supporting girders, running from side to side of the substructure. The girders and the substructure are meant to be of sheet and angle steel; the whole is carried on live rollers and rotated by a circular rack and pinion moved by a steam engine or capstans, which are not represented in the model. The vertical movement of the guns is effected by hydraulic pistons under the top carriage. The water conduits enter through a swivel arrangement in the basement, where there is also a model of the armor-piercing shell; the powder cartridges and one of the trucks which carry them from the magazine to the hoists. Between the guns in the center of the cupola is an iron ladder reaching up to a stand for the commander, enabling him to take aim through a channel in the roof plate and to direct the rotation of the turret accordingly. The diameter of the rotating cupola is 37 feet 1 inch outside and 27 feet inside. The maximum thickness measured horizontally of the plates is over 60 inches, except between the embrasures, where it increases and reaches more than 7 feet in the middle. The outer diameter of the fixed armor belt is about 52 feet. Covering and surrounding this armor belt is a glacis, meant to be of stone and concrete. The cupola presents a comparatively small target, shaped like a turtle's back. The exhibit does not fail to attract great attention.

The Army and Navy exhibits are among the most interesting, not only of those in the Government Building, but also in the entire exposition. We present two engravings, one of the Cyclorama exhibit by the Navy Department, and the models showing government mules transporting fixed ammunition; the latter does not call for special comment, except to show the completeness with which all the interesting features of the service are presented.

The Cyclorama shows the back of a naval vessel and consists of a full-sized model of the port side of the quarter-deck of a cruiser upon which are grouped officers and men of the navy in the different uniforms worn by them. No attempt at likeness was made except in the case of Admiral Dewey, whose uniform is that known as "special full dress," and consists of a dress-coat with standing collar lined with white silk. The collar has around it gold lace one and three-quarters inch wide, and on the cuffs are three bands of gold lace, two of them two inches wide and one of one inch between them, with a gold star above the upper band. Epaulettes are worn, and the sword-belt has three rims of gold embroidery a quarter inch wide, one on each edge and one in the center. The slings for the sword are embroidered in the same manner, except that the edge, etc., is but an eighth of an inch wide. The trousers have a gold stripe on the outer seam, one and three-quarters inches wide. The sword is of the regulation pattern. The cocked hat is bound with gold lace one and three-quarters inches wide. The captain is in "full dress," which is a frock coat with epaulettes, gold-laced trousers and cocked hat bound with silk braid. The sword-belt has gold lines running through it. There are two commanders of the staff and a lieutenant-commander in "dress" uniform, one lieutenant in service dress and a captain of marines in full dress, gorgeous with embroidery from cuffs to elbow. There are two petty officers and a group of seamen. The rail, wheel, skylight, etc., are all natural, being taken from the deck of a cruiser and sent out to be used in constructing this model. At the extreme right is a turret with projecting guns. The background shows the open sea with cruising vessels in sight and approaching. On the exterior of the circular back of the Cyclorama are photographs, hydrographic charts, etc., and the space immediately about the Cyclorama is given up to models of various vessels of the old and new navy, one group being those that were at Manila, May 1, 1898, while in another group are the vessels which engaged in battle at Santiago, July 3, 1898. There is also a half model of the 13-inch gun, split longitudinally, a Spanish torpedo from the "Maria Teresa," a 4-inch breech-loading rifle, a 14-pounder, a 6-pounder, a 3-pounder, a 1-pounder, a surgery and sick bay, as well as exhibits of life buoys, marine corps models, powder, model of a drydock, map of the world showing the daily positions of naval vessels, etc.

The miniature railway at the Pan-American Exposition never fails to attract attention. The railway runs through a beautiful section of the grounds, and its piercing little whistle warns the casual visitor not to walk upon the railway ties. Our photograph was taken just in front of one of the Ordnance Buildings while the engineer was sitting upon the tender.

Not by any means the least striking novelty in the transportation exhibit at the Pan-American Exposition is the Vanderbilt locomotive. The locomotive itself is by this time very familiar to the readers of the SCIENTIFIC AMERICAN. The firebox is circular in cross-section and corrugated, and thereby provides a construction which is cheaper, safer, more durable and less liable to the quick deposit of scale. The adoption of the cylindrical form of firebox proved so satisfactory that it was natural for Mr. Vanderbilt to look for some other part of the locomotive on which the cylindrical construction could be adopted to advantage, and the tender naturally received first attention. As will be seen from our photograph, the tank is of cylindrical form, and the coalbox has been shifted to the front end of it and made considerably deeper than the old form of coalbox. As far as the water tank is concerned, this provides a stronger and cheaper construction, and the coal capacity, in proportion to the amount of water carried, is larger than in the old type. Moreover, the coalbox being at the front end of the tender and much deeper than formerly, the fuel tends to find its way to the footplate by its own gravity, and the work of the fireman is proportionately reduced. The patent for the Vanderbilt locomotive has been sold to the Baldwin Locomotive Works, and this type has already been introduced upon many of the leading railroads of the country, including such roads as the Baltimore & Ohio, the Illinois Central, the New York Central, etc.

Automobile News.

A lady was entering the forest of St. Germain near Paris, in a 16 horse power automobile when the machinery became out of order. The passengers brought the car to a standstill in order to overhaul the engines, when almost immediately a violent explosion occurred and the car was enveloped in flames. The passengers had a narrow escape. The liquid fuel in the reservoir of the car overflowed and became ignited, and it was feared that the burning stream of oil would run among the bushes fringing the road, setting them alight, in which event the forest would have been involved and widespread damage caused. The forest fire, however, was averted by the felling of a few trees and the cutting away of the undergrowth in the vicinity of the burning vehicle. The motor car burned fiercely for about an hour, leaving only a mass of tangled steel and ironwork. The value of the automobile was $5,000.

The Hon. Charles Rolls, one of the foremost automobilists in England, recently delivered a lecture in London concerning the advantages of the motor car over horses. The principal advantages, he explained, were less wear and tear upon the roads, better steering, more room for traffic owing to the small amount of space the motor car occupies, and cheaper transportation. A ton of goods can be transported in England for 40 miles for less than $1.50. He also anticipated that the more universal utilization of motor vehicles would result in an improvement of the breed of horses, since several horses would be relieved from traction for which they were neither suited nor intended by nature. For military purposes the motor car was vastly superior in the transport department. This fact was shown in the present war in South Africa. There was one machine, plying between Commando Nek and Pretoria, a distance of about 26 miles, which accomplished the work for $18 that had previous to its introduction cost $1,200, and also did the same amount of work that 960 trek oxen could perform, and did not require replacing every six weeks as was the case with the animals. The introduction of motors for transport purposes in war would be much more economical, as this instance proves, besides obviating a tremendous amount of awful suffering on the part of dumb animals.

The British War Office has devised a new use for bullets expended upon target practice at rifle ranges. The present market price for spent cupro-nickel bullets is about $90 per ton, and contracts have been made for the recovery and removal of these used bullets from the various ranges.

Engineering Notes.

Hydraulic pressure is being successfully employed at St. Etienne in the manufacture of steel in molds tapering toward the top by pressing from the bottom instead of from the top of the casting, as by the Whitworth process. This is said to produce a more homogeneous steel and to give better results generally.

During the recent Ashantee campaign the megaphone was tried by the British officers for giving orders, since the columns traversing through the African bush were so long that it was impossible to convey orders in the usual way. The experiment was unsuccessful, however, because the thick jungle and the winding paths prevented the sound from traveling.

Rapid progress is being made upon the new reservoirs at Staines, Middlesex, for the supply of London, and it is anticipated that they will be completed in about two years. The reservoirs are approximately 4½ miles in circumference, and their capacity will be 33,000,000,000 gallons, a sufficient supply to serve the district catered for by the water companies to whom they belong for 100 days. The reservoirs will be supplied from the flood water of the Thames.

The Bureau of Foreign Commerce has received from the Tacoma Chamber of Commerce and Board of Trade the announcement that a new line of steamers has been established to ply between Tacoma and Liverpool, via the Suez Canal, touching at Manila and other Philippine ports, all the Straits ports, and those of India, Arabia, Egypt, the Mediterranean, and the Continent. There are nine ships engaged in this line, with a tonnage varying from 4,000 to 11,000 tons.

A unique twin-screw vessel for the Russian navy, the first of its kind ever built, is in course of construction at Kiel. The ship is described as a "training and transport vessel," and is intended for the practical instruction of naval engineers. It is provided with two four-cylinder triple-expansion engines, and all the various appliances and auxiliary machinery indigenous to a modern man-of-war, so that her crew may obtain a thorough practical knowledge of the mechanism of a battleship. The displacement of the vessel will be 12,000 tons, and she will have accommodation for 20 officers and 700 men. She will cost $1,375,000 to construct.

Experiments are being made in the signaling department of the English army with acetylene gas for transmitting signals at night. At present ordinary oil lamps and limelight are utilized for this purpose, but the recent tests with acetylene have proved that the latter medium is much more advantageous. A whiter ray of light with increased brilliancy is obtained, and it is far more penetrative than oil or limelight, and signals transmitted by this means can be read at a much greater distance than heretofore. Another advantage in its favor is that the gas can be generated in about one-twentieth of the time required to prepare a limelight, and it is also so portable that one man can easily carry the plant necessary for two lamps.

Consul-General Guenther, of Frankfort, under date of February 27, 1901, reports that a masonry bridge is being constructed across the valley of Petruffe, in Luxemburg, which will have the largest single span of any masonry bridge, viz., 277 feet of a span width and a rising acclivity of 102 feet. Previous to this, the largest masonry bridge span was that of Cabin John Bridge, near Washington, viz., 220 feet, with a rising acclivity of 57½ feet and a height above the water of 101 feet. Following Cabin John Bridge comes the railroad bridge at Jarenge, over the Pruth, followed by the Grosvenor Bridge, over the Dee, at Chester. These three spans have been among the world's greatest architectural triumphs in bridge masonry.

Twenty years ago the cities of Albany and Troy were the centers of stove manufacture in America. About that time the competition of some Western points began to be felt. While the stove manufacturers of Albany and Troy, appreciated the danger, their skilled employes, banded together in a strong moulders' union, ignored it and argued that the then existing conditions could not be changed. Their locality was nearer the source of the pig iron supply, says Mr. R. W. Hunt, in Cassier's Magazine, and could, therefore, always command cheaper iron; and beyond all, no other points had the same molding sand, and, without that, successful competition against Troy and Albany stoves was impossible. So strike followed strike. In many of these the men carried their points. The conditions governing the employment of apprentices, the hours of labor, and the amount of work produced per man were all satisfactorily controlled; but the development of the natural resources of the great American Northwest was not. To-day the blast furnaces of the Hudson River Valley are a tradition, and the stove foundries of Troy and Albany are diverted to other uses, or else crumbling ruins; while those of Detroit, Aurora, Milwaukee, and other cities farther west are echoing the thud of the rammer, the clank of the molding machine, and the blast of the cupola.

THE COMMON-BATTERY TELEPHONE SYSTEM OF THE CITY OF NEW YORK.

Perhaps a few electrical engineers fully appreciate the scope of the improvements which have been made in telephony since the time when the telephone was first exhibited at the Centennial Exposition of 1876. But the great army of subscribers certainly know nothing of the brains and money which have been lavished upon the elaboration of a telephone system that has reached its highest development in the land of its birth. The transmitter and receiver are all that each subscriber sees; and these show but little of the change which has been wrought. One apparently trifling departure, however, which has of late been noticed in the subscriber's apparatus has told the telephone users of New York that an onward step has been taken; and that departure, the only public sign of this step, is the abolition of the magneto-generator used in calling the central office, and of the sub-station battery.

The system which has thus discarded the magneto-generator and the station-battery is technically known as the "common-battery system," for the reason that it centralizes the sources of energy hitherto distributed among the various sub-stations.

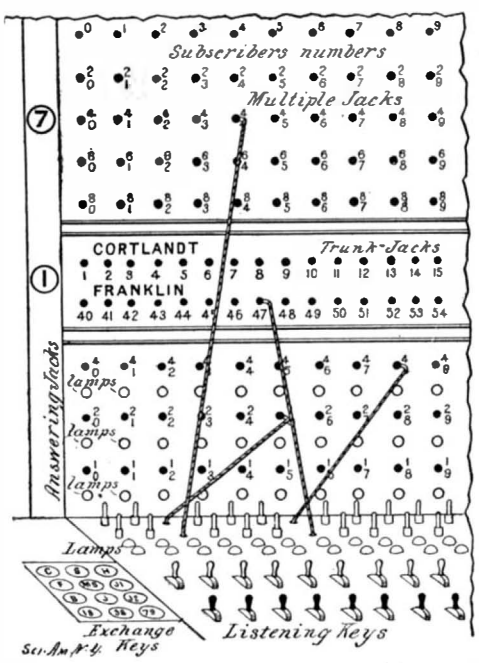
The change from the magneto to the common-battery system has rendered it necessary to reconstruct every telephone-exchange in New York—a reconstruction which has been effected without any inconvenience to the subscriber, even though new stations were added to the system at the rate of one thousand per month. Only on the completion of the new installation were the old boards abandoned.

The common-battery system employed throughout the United States is the result of the labors of many men, among whom may be mentioned Scribner, Hayes, Dean, O'Connell, McBerty, and Carty. It is not the purpose of this article to dwell on the technical features of the system; for they would be of interest only to electrical engineers and telephone experts and would require many numbers of the Scientific American to do them full justice. The labors of Scribner and his compeers must therefore give place to a cursory description of the working of an exchange—that portion of the system which is perhaps of most interest to those who use the telephone in the affairs of daily life.

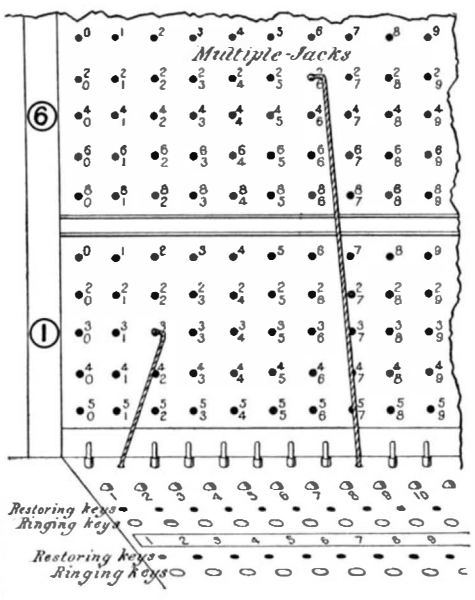
The telephone exchange which we illustrate is equipped with the most perfect apparatus that has yet been devised. Its long multiple switchboard meets the demands of some 5,300 subscribers' stations, the aggregate number of whose calls reaches a total of 41,000 per day.

The multiple switchboard in question is divided into two sections, known at the exchange, respectively, as the "A" board and the "B" board. It is the function of the operators of the "A" board to connect the subscribers of the exchange with each other or with lines, called "outgoing trunk-lines," leading to other exchanges. It is the function of the operators of the "B" board to connect the subscribers of other exchanges, whose calls are received on "incoming trunk-lines," with the subscribers of the particular exchange under discussion.

GENERAL VIEW OF THE MULTIPLE SWITCHBOARD OF A TELEPHONE EXCHANGE.



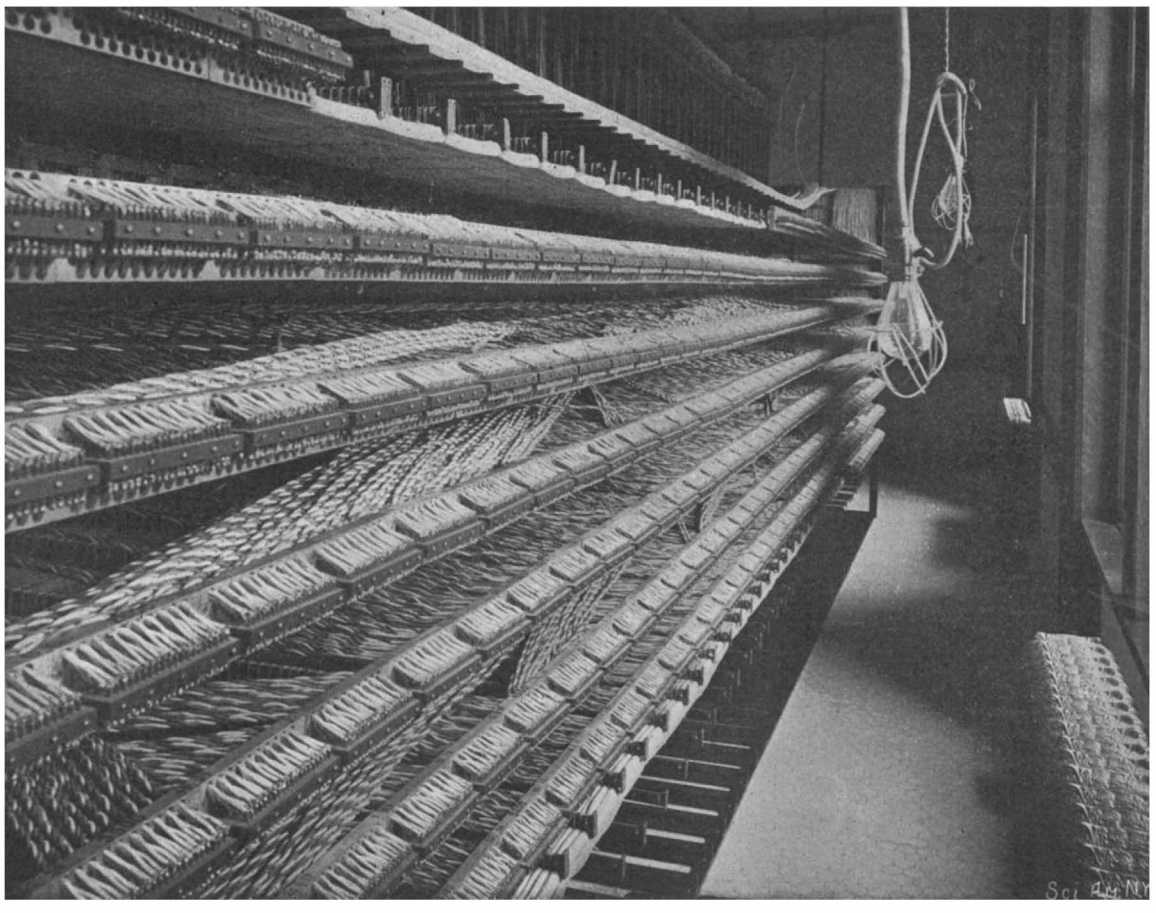
PANEL OF AN "A" BOARD IN DETAIL.



PANEL OF A "B" BOARD IN DETAIL.

Each operator of the "A" board controls seven vertical panels of the multiple switchboard, which panels are each sub-divided into small sections receiving one hundred sockets or "jacks," numbered to correspond with the sub-station lines leading to the exchange. Every operator can reach all the subscribers of the exchange. Beneath the multiple jacks the outgoing trunk-jacks for connecting subscribers of the exchange with subscribers of other exchanges are located. And beneath the trunk-jacks are "answering-jacks," which correspond with the stations of subscribers whose calls the operators must answer. A certain number of subscribers or "answering" jacks are assigned to each operator. Beneath each answering-jack is a small incandescent lamp, which flares up whenever the corresponding receiver at the station is taken from the hook, and is automatically extinguished when the operator connects with the answering-jack to answer the call. In addition to the lamps of the answering-jacks a "pilot-lamp" is used, which glows as long as any subscriber's lamp is alight. It is the purpose of the pilot-lamp to serve as an additional means of attracting the operator's attention to her subscribers' lamp, and to enable her to respond to the call of a subscriber whose lamp may have been burned out. On the horizontal board before each operator two sets of plugs with their cords are seated, in front of which are two series of lamps (supervisory lamps, they are termed) corresponding in number and arrangement with the plugs, and serving as signals to inform the operator when a called subscriber has answered and when she must disconnect two subscribers. Sets of ringing and listening keys complete the equipment of each "A" operator.

When a subscriber calls up the exchange, the pilot-lamp and the lamp of the corresponding answering-jack glow. The "A" operator inserts one of the disengaged plugs of the rear or answering series in that answering-jack and asks the number desired. If the number be that of a subscriber in the same exchange, the operator first taps the edge of the multiple-jack of the station wanted with the tip of the second plug forming part of the circuit which she intends to use. If the line is "busy" she gets a peculiar click in her receiver, a warning not to intrude. If the tapping does not betray a "busy" line, the plug is fully inserted. When the two plugs are in their respective jacks the two lines are connected and then the two corresponding supervisory-lamps show the state of affairs. The inner lamp, connected to the answering-cord, is out because the calling subscriber has his telephone off the hook; the second lamp remains alight until the called subscriber takes down his telephone, when it is automatically extinguished and the operator then knows that the two subscribers are in communication. If the called subscriber fails to answer, the one supervisory signal will glow until by persistent ringing the subscriber is made to respond. When a conver-



INDIVIDUAL SUBSCRIBER WIRES.

sation has ended and both subscribers hang up their receivers, the supervisory signals both again glow, thus commanding the operator to disconnect the two lines.

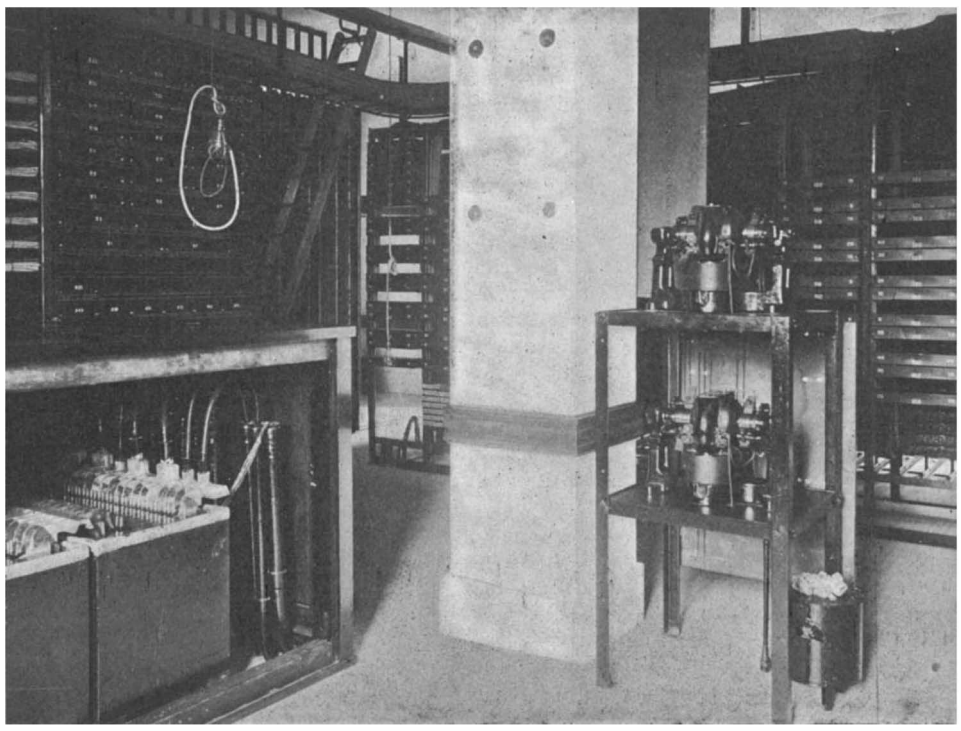
If the subscriber called for be in another exchange, the "A" operator, after having inserted an answering-plug in the jack of the calling subscriber and ascertained the number desired, presses a key to her left, which places her in communication with the desired exchange, informs the "B" operator there what number is desired, and inserts her connecting plug in the particular trunk-jack designated by number by the "B" operator of the other exchange. The desired connection is then completed at the second exchange after the usual "busy" test has been made. The supervisory lamp-signals are here again used to inform both operators when the lines are to be disconnected.

The "B" board of every exchange is provided with multiple-jacks arranged in panels similar to those of the "A" board, so that each "B" operator can reach all the subscribers of the exchange. No answering-jacks are provided; nor are any required, since the operators at the "B" board merely connect other exchanges with called subscribers. Only one set of plugs (incoming trunks in this instance) and one set of supervisory lamps are needed, for the reason that the connections are half completed at the calling exchange. Ringing-keys are provided, which when depressed ring the called station's bell at regular intervals until the subscriber takes down his telephone, when the ringing-key automatically resumes its normal position. A line of auxiliary keys corresponding in number with the ringing-keys is also provided, the depression of one of these keys serving to restore a ringing-key to its normal position when a subscriber absolutely fails to answer. Each operator of a "B" board answers the calls from one exchange. The "A" operator at the calling exchange, after having answered a subscriber, speaks to the "B" operator over a service wire and instructs her what number is desired. The "B" operator designates what disengaged trunk-line should be used by the "A" operator and then inserts the correspondingly numbered incoming plug of her "B" board in the multiple-jack of the station called for, the usual "busy" test having first shown that the line is free. The glowing of the supervisory signal in the circuit of the particular incoming trunk-line used and of the supervisory signal on the board of the calling "A" operator, indicate when disconnection is to be made.

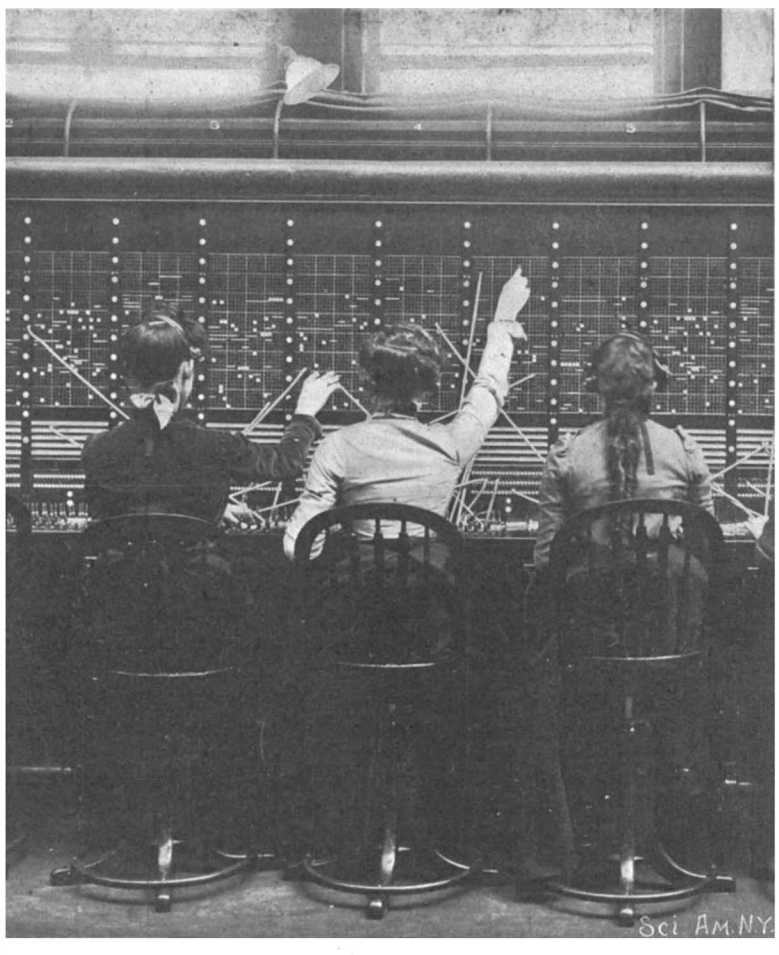
The boards are so arranged that the work of each operator is reduced to a minimum. Only a second is required to ascertain whether or not any given subscriber of the exchange is "busy;" a few more seconds suffice to notify a calling subscriber whether any other station in New York and vicinity is "busy;" a minute or two is all that is required to gather similar information from Boston, Philadelphia, or other outlying towns.

The multiple switchboard is the most expensive and at the same time most efficient central office apparatus ever invented. Its cost is about $1,000 per foot; its elements are numbered by millions. The addition of a number of multiple-jacks to a board means an addition not to one section of the board alone, but to every section; for it is the primary purpose of the multiple board to enable each operator to have within her reach all subscribers' lines connected with the exchange. The multiplying of jacks entails enormous expenditures. But the price of this increase is not the only outlay which may be lavished upon an exchange. So rapid and so radical are the advances made in telephonic communication that an exchange may often be entirely refitted to incorporate a new improvement. Next year's telephone exchange is almost certain to reveal some departure from this year's apparatus. The changes may be slight. They are costly. But they increase the efficiency of the system; and for that reason alone the end justifies the means.

Remarkable as the technical achievements in modern telephony undoubtedly are, it cannot be denied that New York owes its admirable telephone service largely to the admirable organization of the exchanges. Each exchange has its highly-trained corps of operators and chief operators who answer calls and make connections with a celerity not always appreciated; its supervisors who see to it that the operators do their work promptly and aid them if necessary; its monitors, seated at properly-equipped desks, assisting the operators in making difficult connections; its manager, who is the commander-in-chief of this regiment of operators, supervisors, and monitors; and its wire-chief, whose business it is to superintend the technical department.



THE STORAGE BATTERIES AND A SECTION OF THE REPEATING-COIL RACK.



A PORTION OF THE "A" BOARD, SHOWING MULTIPLE-JACKS, OUTGOING TRUNK-JACKS, ANSWERING-JACKS, AND PLUGS.

Distortion in Lantern Slides and Its Cure.

When one sees a lantern show at the present time, one cannot but be reminded of the general superiority of the slides as compared with those produced a decade or so ago. Not that the commercial slides are so much better, but because those now made by amateurs are infinitely superior to the dense black-and-white things that used to be considered good enough to show at the time to which we refer. This superiority, in a great measure, is due to the excellence of the plates now supplied, specially for transparency work. Till these were on the market the amateur had, perforce, to be content with the ordinary plates that were intended for negatives. At times, however, one does see slides shown that, though in all respects photographically perfect, are marred by the distortion of perpendiculars. This is most unpleasant to the eye when seen upon the screen, particularly if the lines happen to come in close proximity to the edges of the mask, and that is rectangular. This distortion of convergence, it is needless to say, is caused through the camera not being placed level when the negatives were taken. This might easily have been avoided if the camera had been used on a stand, but not so easily if it were held in the hand, notwithstanding that it might be provided with spirit or other levels. Again, it is often impossible to obtain the whole of a high building in a picture unless the camera is pointed upward, and comparatively few hand cameras are furnished with a swing back, or rising front, which would enable the distortion caused by the tilting to be avoided. Even if the hand camera were provided with a swing back it is doubtful if the novice would always employ it with sufficient judgment to obviate the convergence of the lines, for the image, as seen on the finders, does not always coincide with what is included in the negative.

If the camera is provided with a rising front, with sufficient rise to avoid the trouble, we are met with the difficulty that the majority of hand cameras are supplied with lenses that are only capable of fairly covering the plate when they are fixed at its axis, and, if they are raised much beyond that, the lower corners of the negative suffer. The case would be different if all cameras were provided with lenses of the anastigmatic type, which have a great covering power, and even illumination over a wide field. Although the lines may be out of the perpendicular in the negative, there is no reason why they should be in lantern slides made from them, for the evil may be corrected.

Supposing we have a negative of a building in which the lines converge toward the top, owing to the camera being pointed upward when it was taken in order to include the whole of the subject in the picture. Now, what we have to do to render the perpendiculars parallel is to enlarge the upper portion of the image and reduce the lower portion, then we shall get the picture as it should be. This, of course, can only be done when the slides are made by camera printing. If we put the negative in the dark slide of a camera with a swing back, and adjust it so that the top of the negative is nearer the lens than the bottom, and the image is received on the ground glass of a second camera placed in front of it, the perpendiculars will be seen corrected, provided, of course, that a suitable slope be given to the negative in the swing back, and that is easily adjusted. But it will be obvious that, as one portion of the negative is nearer the lens than the other, all parts will not be in sharp focus with its full aperture, therefore it must be considerably stopped down in order to get all portions sharp. The best method of obtaining that in practice is to first sharply focus the center of the picture with a medium stop, and then put in the smallest one with which the lens is provided.

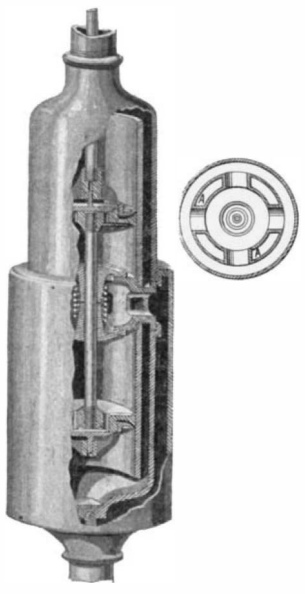
If the negative requires a very great slope to correct the distortion, it may be found impossible, even with the smallest stop, to get all parts sharply defined. In that case it will be advisable to make the correction indirectly, making a transparency in which the convergence is but partly cured and then from that adopting the same means, making a new negative, which may then, if desired, be used for contact printing. If this procedure is found necessary, the transparency should be more fully exposed and made denser in the development than if it were to be used direct as a lantern slide.

As some may not have a second camera, or one with a swing back, then an ordinary copying camera, such as is used for lantern-slide making, may be utilized by fixing the negative in the camera in a sloping position. This may easily be done with the aid of a wedge-shape strip of wood or a couple of wedge-shape pieces of cork, adjusted so that, while one end of the negative is in the rabbet of the holder, the other is kept the required distance away by the wooden wedge or the corks, as the case may be. This extemporized arrangement is readily secured in position with a few drawing pins. When the slope necessary for the negative is very great, it will be a good plan to place a piece of ground glass an inch or two from it, at the back, so as to insure its even illumination, which, in some circumstances, might not otherwise be attained.—The British Journal of Photography.

AN IMPROVED DOUBLE-CYLINDER FORCE-PUMP.

The accompanying illustration represents a new force-pump invented by William G. Fetrow, of Mechanicsburg, Pa., for use in pumping water from shallow and deep wells, including artesian wells.

The pump comprises aligned upper and lower cylinders in which valved plungers reciprocate in unison. Between the two cylinders is a valve-holder provided with valve-seats, and with side openings and vertical passages, *A*, forming part of a discharge-chamber. The valves on the seats open into the cylinders. A casing surrounds the lower cylinder, forming an annular space communicating with the lower end of the lower cylinder and with the passages, *A*, in the valve-holder. The upper cylinder is also surrounded by a cylinder, forming an annular space opening to the valve-holder passages *A*. These passages and the annular spaces constitute a continuous discharge-chamber for the lower cylinder and the upper end of the chamber leading to the pump-discharge-pipe.



A NEW PUMP.

A shell surrounds the valve-holder and the lower casing to form a suction-chamber, discharging into the side openings of the valve-holder. The upper end of the upper cylinder and the upper end of the discharge-chamber open into a discharge-pipe on the upper end of the upper casing.

On the down-stroke of the plungers the water in the lower end of the lower cylinder is forced out through the discharge-chamber to the discharge-pipe, and at the same time water is drawn into the upper part of this cylinder by means of the valve-holder and the suction-chamber. During the downstroke of the upper plunger the water previously drawn into the lower end of the upper cylinder passes through the valve in the plunger to the upper part of the cylinder; and on the upstroke of this plunger the water in the upper part of the cylinder is forced up through the discharge-pipe. During the upstroke of the lower plunger the water previously drawn into the upper end of the lower cylinder passes through the plunger-valve to the lower part of the lower cylinder, to be forced on the next downstroke of the plunger.

A New Compound Tartaric Acid.

M. L. J. Simon has recently discovered a new body which possesses some interesting properties. He describes his experiments in two papers read before the Academie des Sciences. In the calcination of tartaric acid in presence of bisulphate of potassium, besides the pyruvic and pyrotartaric acids usually formed, there is produced a new acid which the experimenter has been able to isolate in the following manner. The product of calcination is submitted to distillation under reduced pressure; as soon as the commencement of the decomposition prevents the formation of a vacuum, the residue of the distillation, brown and viscous, is taken up with alcohol and boiled for several hours with a gradual lowering of temperature so as to produce etherification of the acids in the mixture. The whole is again distilled under reduced pressure, and pyruviate of ethyl passes off, with a little free pyruvic acid, then diethylic pyrotartrate; the distillation is stopped and the residue transferred to a retort and distilled at the ordinary pressure. A yellowish oil passes over which partly solidifies when cold. It yields a crystalline deposit, whose weight is but 1-1000th of the original weight of the material. These crystals form a new compound which has been studied by the experimenter. The crystals, purified by crystallization from hot alcohol, melt at 164 deg. C. and resolidify at 156 deg. The new compound sublimes easily under the action of heat, forming white needles and sometimes transparent scales; it commenced to volatilize at 110 deg. It crystallizes from alcohol in small prisms. It is somewhat soluble in boiling water (about 4 per cent), and upon cooling it crystallizes in fine needles which melt also at 164 deg. Ether dissolves it, and will remove it from its solution in water; upon evaporation, it appears in very brilliant crystals, which have a high refracting power. It is also soluble in acetic acid. This body is a feeble acid; its potassium salt is prepared by dissolving caustic potash in a very little water; the acid is added and dissolved by heating; and the whole is evaporated until the brownish liquid is covered with a solid film. Upon cooling, the whole forms a solid mass, and when spread out dries rapidly, becoming perfectly white This potassium salt crystallizes in plates which are very soluble in water and alcohol, the solution being alkaline. It contains two molecules of water of crystallization, and corresponds to the formula $C_7H_7O_3K$, $2H_2O$. The acid itself has a composition represented by $C_7H_8O_3$, as shown by analysis. This acid is not saturated; it takes up bromine at ordinary temperature, as does also the potassium salt. The acid and salt reduce a permanganate solution, but have no effect upon Fehling's solution. With acetate of lead a white precipitate is formed, and with acetate of copper a light green precipitate. Wislicenus and Stadnicki discovered in 1868, in the dry distillation of tartaric acid, an acid melting at 134.5 deg., soluble in 400 parts of boiling water, and to which they gave the name of pyrotartaric acid, with the formula $C_7H_8O_3$; this acid was afterward identified with the dimethylfurfurane-carbonic acid, prepared by other experimenters in different ways. The acid found in the present case is isomeric with the pyrotartaric acid, but is certainly distinct from it. In a second communication, M. Simon describes some later work with the same compound. The acid, to which he gives temporarily the name isopyrotritaric acid, has a characteristic property, possessed by none of the other compounds formed at the same time. Its solution in water gives with the ferric salts, especially the chloride, an extremely intense violet coloration which recalls that of permanganate of potassium. This reaction is very stable, and is not changed by heat or with time; it disappears upon adding a few drops of concentrated acid, but reappears by adding water. Diluted alkalis change the color to orange red, or in excess, precipitate ferric hydrate. Inversely, when an acid is now added, the hydrate is dissolved and the orange red color appears, then the violet, and an excess of acid causes discoloration. These variations of color are due to a ferric combination which the experimenter has isolated by digesting precipitated ferric hydrate with a hot saturated solution of the acid in question, and the solution thus obtained when dried in vacuo deposits small dark red crystals having the composition of a ferric isopyrotritarate, $(C_7H_7O_3)$ 3Fe, $2H_2O$; this salt dissolves in water and gives it a bright red tint. It constitutes a very sensitive indicator for acidimetry, the change from rose to yellow is very distinct and is well marked in both directions. The acid may be used to advantage to show the presence of ferric salts, as the reaction indicates 1-100,000 part if in neutral solution, and is as sensitive as that obtained with sulphocyanide of potassium. This reaction distinguishes it from the pyrotritaric, pyrotartaric and pyruvic acids; salicylic acid gives similar, but not identical, reactions.

A MINIATURE ELECTRIC CARRIAGE AT THE PAN-AMERICAN EXPOSITION.

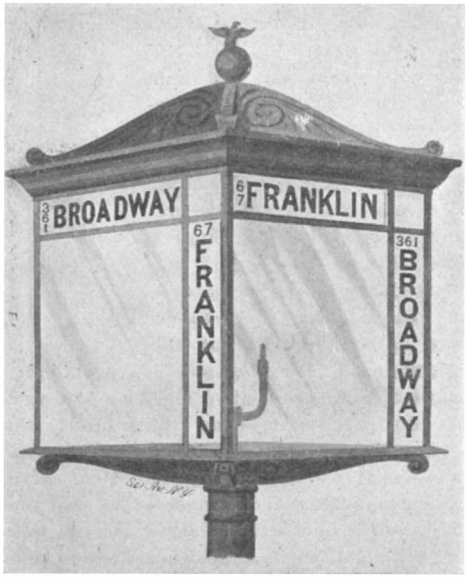
The smallest automobile ever built is that made by the Jenkins Automobile Company, of Washington, D. C., for Chiquita, the little 26-inch morsel of humanity, who is now using it at the Pan-American Exposition. It is a little electric victoria, complete with leather top, fenders and cushions, electric lights, gong, and wheel steering gear. It is, in fact, so exact a miniature duplicate of a full-sized automobile that it is difficult to fix its real proportions in one's mind. It has 12-inch wheels, fitted with 1¼-inch Diamond pneumatic tires; electric lights showing red and green on sides; a top which raises and lowers. The cushion is 14 x 8½ inches, and but 14 inches from the ground; the step is but 4 inches up. The front and rear axles are 24 inches apart, center to center, and the truck is 24 inches wide. With top up it does not come up to one's elbow. It is guaranteed to run for two thousand hours over level surface with absolutely no attention except that required to guide and control it. The motor is hung beneath the body on the truck and connects with the gear on the differential directly on the rear axle. Both rear wheels drive.

A MINIATURE ELECTRIC AUTOMOBILE.

While the little machine is suitable for use in the streets, it is unequaled for stage or indoor use, kindergarten or playground. There is no fire, no water or boiler; no gasoline or other explosive or inflammable fluids; no acids or heavy lead batteries. It requires no expert attendant; a child can use it as safely as a bicycle. Some idea of the size of this little machine can be had from the photograph showing it standing beside the wheel used on a big steam coach made by the same company.

A NEW STREET SIGN FOR LAMP-POSTS.

Those who ride in city surface cars know that it is not the simplest thing in the world to catch a glimpse of the street signs which, in New York city, at least, are placed probably in the most undesirable and awkward position conceivable. For the convenience of street-railway passengers the avenue lamp-posts in New York were, some time ago, turned through a right angle so that the name of the street could be more easily read. But pedestrians were so confused by the turning of the lamp-posts and protested so hotly at the change that the city fathers were compelled to restore the lamp-posts to their old positions.



A NEW STREET SIGN FOR LAMP-POSTS.

The difficulty of providing a clear street-sign which will answer the needs of both car passengers and pedestrians has been neatly overcome by Mr. John A. Sleicher, the editor of our esteemed contemporary, Leslie's Weekly, 110 Fifth Avenue, New York city. In addition to the usual horizontal sign which designates a street, Mr. Sleicher's lamp-post bears a vertical sign designating the street or avenue intersected. A passenger in a car can see at a glance that the avenue along which he is traveling is, for example, Broadway, and that the street which he has just passed is Franklin, the first legend extending horizontally and the second vertically. The pedestrian finds similarly that the street along which he is walking is Franklin and that the avenue which he is about to cross is Broadway. He need not walk around the lamp-post to ascertain the name of the avenue.

Mr. Sleicher's lamp-post is now under consideration by the Municipal Art Society of New York, and will doubtless meet with the approval of that organization.

The New Zinc Field.

BY WALDON FAWCETT.

The preliminary statistics covering a considerable portion of the year 1900 prove conclusively that there has been no exaggeration of the resources of the developed and undeveloped zinc and lead properties of the Missouri-Kansas district, constituting the great American zinc belt, and regarding which some seemingly remarkable predictions have been made during the past year or two. This district, which lies principally in southwestern Missouri, and will ultimately develop into one of the great mineral centers of the world, has been worked in a desultory sort of way for almost half a century, and it waited upon the advent of Eastern capital within the past couple of years to bring the ore production to its present yield, which approximates one million dollars per month.

It was not until 1874 that a geologist touring the district discovered the true nature of the mineral being scattered on the dumps. Then there was a rush to secure the stocks on hand at the various properties, and when the statistics for the decade were made up in 1880 it was found that there had been sold nearly sixty thousand tons of zinc, as against one hundred thousand tons of lead. In 1897 the district produced 5,000,000 worth of ores, or nearly as much as during the whole ten years from 1870 to 1880, and in 1898

the balance sheet showed an aggregate production estimated at $7,000,000.

Meanwhile a change was wrought, and lead instead of zinc became the by-product. An increasing degree of attention was paid to the more recently discovered mineral, until at the present time ten dollars' worth of zinc is produced for every dollar's worth of lead taken from the ground. This new field has enabled the United States to become an important factor in the zinc market of the world. A few years since America contributed scarcely one-eighth of the world's supply. At the present rate of increase this country will ere long furnish more than one-fourth of the aggregate consumption. This little tract, which is now yielding as high as $300,000 worth of zinc ore per week, is at present supplying fully seven-eighths of all the zinc used in the United States, and it must therefore be apparent that the export trade has not as yet undergone any considerable development, but this is only a question of time, and in anticipation of it a number of the smelters of Belgium and Wales have already established agencies in Joplin, the commercial center of the mineral belt.

The three zinc ores found in the district are the sulphide, silicate and carbonate. The sulphide, which is at once the most abundant and most valuable ore, occurs in several varieties, distinguished chiefly by color. The purity of this ore is well illustrated by the fact that it seldom runs below sixty per cent metal, and in some cases it is practically chemically pure, running two-thirds metal and one-third sulphur. The future developments in the working of the zinc properties are difficult of prediction, not only because geologists contend that still larger bodies of ore will be found at greater depths than have yet been reached, but also by reason of the irregular distribution of the zinc ore; it being found in thin sheets in crevasses of limestone; in huge chambers; buried in clay; disseminated through solid brecciated rock which requires blasting, and forming a lining for cavities. Zinc and lead are very frequently mined together, the two ores being found in close proximity.

Not only do the peculiarities already noted exist, but the distribution of the zinc ore is by no means regular, and the test drills have pierced half a dozen strata. All the mining yet done has been at shallow depths. The Eleventh Hour, the deepest mine operated in the district, is only 240 feet deep, and the average shaft has a depth of not more than half that distance. Deep drilling has shown, however, that beyond the four hundred-foot level there are larger bodies of mineral deposits than in any of the shallow diggings now being worked. It is now estimated that it will require twenty years to exhaust the surface workings and get down to the workings of only two hundred feet and over, so that it will doubtless be some time before the miners are ready to get at the five hundred foot level, which experts declare will contain more ore than all the shallow mines combined.

The formation of the district is such that very little timber support is required in any of the mines. The mines are free from fire damp, and the miners are subjected to none of the inconveniences which must be borne by coal miners, who necessarily operate in very cramped quarters. Frequently these zinc miners work in great caverns two hundred feet in length, perhaps a third as wide, and fully forty feet in height —a chamber of sufficient size to insure the presence of good air.

The cleaning of the ore is a somewhat complicated operation. Immediately upon its arrival at the surface it is transferred to huge bins in the mills, from which it is fed into the crushers, a good-sized stream of water being turned into the crusher simultaneously with the raw material. The ore after it has been crushed to the fineness of sand, is carried by the water into sluice boxes, which are provided with false bottoms that collect the ore and allow the dross to escape in much the same manner that gold is washed out of gravel by placer miners. It is during the cleaning process that the lead and zinc are separated, the former having nearly double the specific gravity of the latter. The average mill has a capacity of one hundred tons per day, but each one hundred tons of material fed into the crushers yields only about one-tenth that amount of pure cleaned ore. This may seem a surprisingly small proportion, and the mine operators themselves agree that there is a tremendous waste, but say that the loss will shortly be greatly reduced by the introduction of improved methods.

There has been in the history of the development of America's natural resources few instances to parallel the manner in which the prices of zinc have gone up within the past few years. The average for the year 1897 was slightly over $18 per ton; for 1898, $21 per ton, and for the year which closed in June, 1899, over $34 per ton. More surprising still is the fact that in the first six months of 1899 the average price of all the zinc sold in the Joplin district was $44 per ton, and in some instances sales were made at $55 per ton. Some idea of the profits made possible to the producers may be gained from the fact that the average cost of production does not exceed $14 per ton, and in many localities the ore can be cleaned and made ready for market at a total expenditure of $10 per ton.

There are almost eight hundred mines in the Joplin district, and they give employment to over ten thousand men. All classes of citizens have engaged in the mining operations, some with almost no capital. In other cases a group of miners will go into partnership with some local merchant, who furnishes the money with which to purchase powder and the necessary tools. Joplin, which a few years ago was little more than a village, now has a population of thirty thousand and there are in the district several other mining camps, all of which are connected by the longest electric railway in the world.

The Building Edition for July.

The SCIENTIFIC AMERICAN Building Edition for July is a beautiful number of this artistic periodical. In addition to houses of various prices there are a number of illustrations of the Pan-American Exposition and also a very important interview with Mr. John M. Carrère on the Pan-American Exposition. Among the other attractive features are a Spanish-American house at Alhambra, and two English gardens accompanied by two beautiful illustrations. An editorial is devoted to "The Situation of the House." The departments of this issue are "Monthly Comments," "Talks with Architects," "New Books," "Household Notes" and "New Building Patents."

The Current Supplement.

The current SUPPLEMENT, No. 1332, has many important articles. "Greek Gold Ornaments from Scythia" describes the remarkable examples of ancient gold jewelry presented to the Metropolitan Museum of Art by J. Pierpont Morgan, Esq. "The Rise and Development of Egyptian Art" is by Prof. W. M. Flinders Petrie. "The Sea Bottom—Its Physical Conditions and Its Fauna" is by Prof. C. C. Nutting. "The Making of a Great Atlas" is by Spencer Townsend. "The Manufacture of Portland Cement in California" is by Edwin Booth. "Historical Geology" is by Prof. W. B. Scott, of Princeton University. "Astronomical Laboratories" is an article by Arthur R. Hinks. "Installation, Operation and Economy of Storage Batteries" is by Ernest Lunn and is accompanied by a number of illustrations and diagrams.

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RECENTLY PATENTED INVENTIONS.

Mechanical Devices.

STRIPING AND ORNAMENTING DEVICE.—WILLIAM M. GLENZINGER, Fernandina, Fla. This device conveniently and effectively applies gold leaf and other thin sheets of material to woodwork, and may be used to apply any color or pattern desired. It comprises means for carrying a roll of the article applied, which is in the form of a long strip with a suitable cement on one side, the device having a moistening appliance so as to wet the cement.

COIN-CONTROLLED VENDING-MACHINE.—CHARLES DUHAMEL, Rue Le Pelletier 11, Paris France. The discharge of the article is controlled by the insertion of a coin. The articles to be delivered are preferably of a uniform shape to facilitate delivery. To prevent fraud the coins must be inserted through a slit of a given length. Coins of smaller diameter than the length of the slit have no action.

TIRE REMOVING AND REPLACING DEVICE.—CLARENCE G. DINSMORE, Staatsburg, N. Y. This device comprises an arm adapted to engage with one end one side of a wheel-rim, the arm being fashioned to extend transversely over the tire. A lever is pivoted to the other end of the arm; and a presser-plate is carried by the lever and adapted to engage the tire at the side opposite the one on which the arm engages the wheel-rim. The tool is easily manipulated, and enables the operator readily to remove the tire from the rim.

DUPLICATE SALES-RECORDER.—JOHN T. GILBERT, Eufaula, Ala. The invention relates to devices for producing duplicates of memoranda, by the use of a number of paper strips with interposed carbon paper. The apparatus is provided with an efficient mechanism for feeding the paper a predetermined distance and, with another mechanism for perforating the paper, to facilitate the tearing off of the slips written upon.

SURGICAL TABLE.—CARLOS F. DÁRDANO, San Salvador, San Salvador.—In this surgical table the various parts are adjusted to facilitate placing a patient in different positions. The table comprises a frame on which legs are supported; a table-top formed in two sections hinged together; a rack connected with the pintle of the hinges; and a pinion with which the rack is engaged, by which to move the rack.

Railway Appliances.

CAR-LOADER.—SAMUEL E. KURTZ, Sac City, Iowa. The apparatus carries grain or other material into a car and simultaneously loads or discharges the material toward opposite ends of the car. The grain passes through a hopper into a conveyer tube extending through the doorway of a car. A screw-conveyer forces the material to the end of the tube where it will be thrown by a rapidly rotating fan toward opposite ends of the car. The apparatus is comparatively light, so that it can be readily handled.

Miscellaneous Inventions.

COMBINED FEED-BOX AND SEAT.—ROBERT C. JARVIS, West Pullman, Ill. This invention provides a feed-box for a team, which box, when not needed, can be used as a seat, and which, when required, can be quickly and conveniently secured upon the tongue of a vehicle. The construction is simple, durable and cheap.

HEATER.—JAMES M. JEFFREY, Waynesville, Ill. The heater is designed to be used in connection with brooding-rooms, and comprises a main flue under the floor of the room, leading from the furnace to a smokestack, and a number of risers on the main flue, these risers extending through the room and having removable caps for opening or closing their outer ends. When the caps are removed the products of combustion pass out through the risers. By manipulating the damper of the smokestack and the caps of the risers, the temperature of the room can be readily changed.

PROVISION-BINDER.—HENRY WEIL and SAMUEL SCHWEISHEIMER, Manhattan, New York city. The object of the inventors is to provide a device which may be quickly fastened around boned ham or other meats, and which will dispense with the usual binding strings. The binder consists of a skeleton frame formed of a series of straight wires laced to a series of circularly-bent wires which are separated at one side.

BADGE.—BENJAMIN HARRIS, Manhattan, New York city. This invention relates to certain improvements in the means for holding in place the pins of badges and like articles which are to be attached to one's clothing. To this end the invention comprises a pin, the shank of which is bent back preferably parallel with the body of the pin and held in a casing or sleeve forming part of the collet or annulus to which the base of the badge is generally fastened, this part of the annulus extending inwardly from and preferably across from one side to the other.

SHADE-ROLLER.—CHARLES F. F. FLOS, New York city. A portion of the shade-roller is so constructed that a retaining device is longitudinally formed therein. In this device one end of a shade can be quickly and conveniently entered. The device serves to hold fast the entered portion of the shade without the aid of cement or tacks. The retaining device does not tear or mutilate the cloth.

BOTTLE-STOPPER.—JOSEPH FELDMANN, Manhattan, New York city. This stopper is especially adapted for beer-bottles, and effectually seals the mouth even though the glass may be chipped or broken. The stopper and its attached gasket are made to enter the mouth of the bottle to a much greater extent than the ordinary stoppers, the gasket itself bearing against the inner face of the neck of the bottle from the upper edge to some distance within the neck.

STOOL.—ALBERT F. CURRIER, St. Regis Falls, N. Y. The stool is a piano-stool of improved construction, and is arranged to move horizontally to enable the user to reach about in the immediate neighborhood without leaving the seat.

SWINGING HOSE-RACK.—REUBEN D. WIRT, Independence, Mo. The invention provides a hose-rack or swinging support for folded hose, which rack is adapted to prevent the hose from leaving the rack in a mass when pulled upon at the upper end, thereby preventing the hose from becoming entangled when it is quickly withdrawn.

CONVERTIBLE TRUNK AND WRITING-DESK.—LAURA E. BUCKINGHAM, Manhattan, New York city. This convertible trunk and writing-desk is arranged to be conveniently converted from a trunk into a writing-desk, or *vice versa*, so that the owner may use the structure as a trunk when traveling, or as a writing-desk when at home.

PUMP-BOX.—JOSEPH H. RODGERS and JOHN A. POWELL, Pittsburg, Penn. The pump-boxes of ships are built from deck to floor and are intended to receive the pumps by which the vessel is kept clear of water. Ordinarily these boxes are built of wood, and are liable to be broken by the cargo, especially in loading and unloading the vessel. This invention seeks to overcome the objection by forming a box of metal pressed into the proper form.

COMBINED NECKTIE-FASTENER AND COLLAR-BUTTON.—ORIN H. PEAK, Parsons, Kans. The invention relates to improvements in necktie-fasteners and collar-buttons in which a spring, levers, and pins or points hold the necktie in position, the whole constituting a collar-button. The invention provides novel levers and points to hold the tie and bow in place.

APPARATUS FOR THE DESTRUCTIVE DISTILLATION OF WOOD.—GEORGE O. GILMER, New Orleans, La. By the simple construction invented by Mr. Gilmer, the vapors from the closed retort are drawn from the bottom, while the heat is applied to the top of the retort, so that the top portion of the wood will give off its vapors first. These vapors are made to descend through the cool wood below, so that the turpentine vapors, which are first given off, are discharged uncontaminated by the tarry or creosote vapors.

PROJECTILE.—ALVIS F. CROOM, 180 Bryan Street, Dallas, Texas. The cylindrical body and conical point of the projectile are provided with two opposite spiral semi-circular grooves. When fired from a smooth-bore gun, the inventor states that the projectile will rotate once in every eight or ten inches of its flight and maintain a flat trajectory for a comparatively long distance. The invention is designed to reduce the cost of manufacture of guns by providing projectiles which, when discharged from the muzzle, will rotate as if discharged by a rifle.

KNOCKDOWN CAMP-STOVE.—STEPHEN J. COCHRAN, Silex, Mo. The body of the stove is composed of six separable parts connected by sliding joints. The body of the oven is composed of four parts which are supported by and between the sides of the body, the sides forming the ends of the oven. The detachable connection between the parts of the oven and stove body is constructed upon the principle of tenon and mortise.

CARTRIDGE-CARRIER.—EDWARD T. GIBSON, U. S. A., Fort Harrison, Helena, Mont. The object of the invention is to provide paper cases in which are placed the number of cartridges required to fill the magazine of a Krag-Jorgensen rifle, or any other suitably constructed breech-loading gun. The paper case is so shaped as to bunch the cartridges together compactly so that they cannot pound each other; but in order to be prepared to interpose strips of paper between them, should it be deemed advisable, and at the same time not interfere with the free "running" of the cartridges from the paper, an intervening piece is provided. The cartridges will readily roll out of the case when the intervening space is formed as the inventor desires.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

First Aid to the Injured and Ambulance Drill. By H. Drinkwater. London: J. M. Dent & Co. New York: The Macmillan Company. 1901. Pp. 104. 16mo. Price 40 cents.

The number of books published on this subject is legion, but this is one of the best we have ever seen. Its very moderate price places it within the reach of everyone. A general knowledge of ambulance work should be possessed in many of our small towns and cities where there is no regular ambulance service.

A Textbook of Plant Diseases. By George Massee. New York: The Macmillan Company. 1899. 480 pp. Price $1.60.

This volume forms a complete handbook of Vegetable Pathology, or the study of plant diseases. By studying it at odd moments, any grower of plants may learn what diseases his particular species is subject to, and how to prevent, or, failing this, to combat them in the most approved manner. The book will be found invaluable to all florists and gardeners.

Bugle Calls. By Benjamin Wood. New York: Brentano's. 1901. 184 pp.

This book is both interesting and unique, for it gives the convictions and opinions of a very large employer of labor on the trade union question, and is about the only book we have seen coming from such a source which upholds the dignity of labor and believes in the union. The book is valuable, since it gives the results of experience in employing union labor, and shows the many dangers that labor is threatened with in America.

Telephone Lines and Their Properties. By William I. Hopkins. New York: Longmans, Green & Company. 1901. 302 pp., numerous illustrations.

This book is intended as a help and guide for both the practical telephone man and the student. It covers the whole subject broadly, including the establishing of lines and the operation of exchanges; but is devoted chiefly to the questions of interference with the telephone currents from outside sources, such as electric railways. Any mathematical demonstrations that seem necessary are included in footnotes. The book has entered its fourth edition, and will prove interesting and instructive to the general reader.

The Romance of the Heavens. By A. W. Bickerton. New York: The Macmillan Company. 1901. 276 pp. Price $1.25.

In this most interesting little volume the author sets forth a new theory of the origin of the solar system—the impact theory. He shows how many observed phenomena—such as variable stars—can be accounted for by the use of such a theory, and that it is likewise applicable to the origin of the universe and solar system. The book is non-technical in language, and may be read appreciatively by anyone with but slight knowledge of astronomy.

Recenti Progressi Nelle Applicationi Dell' Elettricita. Di Rinaldo Furrini, Professore nel R. Instituto Tecnico Superiore di Milano. 3a edizione completamente riffata. Milan: Ulrico Hoepli. 1901. Pp. 277, 109 illustrations.

Lee's American Automobile Annual for 1901. Edited by A. B. Chambers. Philadelphia and Chicago: Laird & Lee. 1901. Price $1.50.

This volume includes a brief history of the automobile and discusses various types. Its illustrations do not warrant special comment.

Practical Advice for Marine Engineers. By Charles W. Roberts, M. I., Marine Engineer. London: Whittaker & Company. New York: The Macmillan Company. 1901. 16mo. Pp. 150. Price 75 cents.

The author is a practical engineer, and he has produced a work which is of value to all marine engineers. It will be specially welcome to junior engineers who desire to grasp the general ideas which should govern the management of steamship machinery.

Six Months Abroad on $300. An Account of a Tour Taken by a Gentleman and His Wife. Carrollton, Mo.: E. H. Kellar. 18mo. Pp. 43. Price 50 cents.

The author describes a trip to Europe and the East, the accommodations being in the steerage and in inferior classes on the railways. To those who enjoy traveling in this manner the book may be of some assistance, but it is safe to say that the intense annoyances and discomforts of this mode of traveling do not compensate for the money saved by a thousandfold. Americans should not go abroad until they are able to go at least in the second cabin of a good liner.

Prime Nozioni Fondamentali di Elettrochemica. Alfonso Cossa. Milan: Ulrico Hoepli. 1901. Pp. 113.

Conti e Calceli Fatte. I. Gersi. Milan: Ulrico Hoepli. 1901. 18mo. Price 50 cents.

Modern Methods of Saving Labor in Gas Work. By C. M. Brackenbury, A.M. I.C.E. London: P. S. King & Sons. Pp. 64. Price $1.60.

A most valuable monograph on the subject. While the literature of gas-making is by no means limited, we do not know of any work dealing with this particular phase of the subject. The very latest devices and methods are described. It is well illustrated.

Select Bibliography of Chemistry. 1492-1897. By Henry Carrington Bolton. Sec. 8. Academic Dissertations, Smithsonian Miscellaneous Collections, No. 1,253. Washington: Smithsonian Institution. 1901.

Dr. Bolton has done a signal service to science in his monumental "Bibliography of Chemistry." He has practically devoted his life to this work, which is, of course, a pure labor of love, which could not be published by any one but a governmental institution. We commented favorably on the first volume when it appeared, and we have nothing but words of praise for the present volume.

Pure Air, Ozone and Water. By W. B. Cowell. London: Scott, Greenwood & Company. New York: D. Van Nostrand Company. 1900. Pp. 85. Price $2.

This is a practical treatise on the utilization of air, ozone and water in oil, grease, soap, paint, glue and other industries. It deals with the purification of air and water, and also of the generation of ozone and their utilization. The value of pure air for oxidation, purification, etc., is well known, but the practical utilization by means of cheap methods has not until recent years been fully realized.

Elevation and Stadia Tables. For Obtaining Differences of Altitudes for all Angles and Distances: Horizontal Distances in Stadia Work, Etc., with all Necessary Corrections. By Arthur P. Davis. New York: John Wiley & Sons. 1901. 12mo. Pp. 43.

The present volume, which includes hydraulic tables for giving velocity for various tunnels and slopes, will undoubtedly prove of great value to engineers.

A Practical Treatise on the Leather Industry. By A. M. Dillon. Translated by Frank T. Addyman. London: Scott, Greenwood & Company. New York: D Van Nostrand Company. 1901. 8vo. Pp. 505. Price $10.

The literature of leather is limited. Most of the more important books have been suffered to go out of print. The sale of books on this subject is always limited, and for this very reason we welcome most gladly the appearance of a translation of an important French work. The French methods and practices which are described are of deep interest to English and American tanners. It is a book which we can recommend most highly to all who are desirous of obtaining a thoroughly up-to-date book on the leather industry. It is well illustrated and is handsomely printed with a wide margin, and is attractively bound.

The Chemistry of Several Natural and Artificial Heterogeneous Compounds Used in the Manufacture of Porcelain, Glass and Pottery. By Simeon Shaw, LL.D. London: Scott, Greenwood & Company. New York: D. Van Nostrand Company. 1900. 8vo. Pp. 713. Price $5.

This classic work is reissued in its original form by the publishers. It is one of the classics of both ceramic and chemical literature. It was first issued in 1837, and has been known for a long time as a valuable book. In its present form it should have a considerable sale. It is filled with most valuable information for the pottery chemist.

Researches on the Past and Present History of the Earth's Atmosphere. By Dr. Thomas Lamb Phipson. London: Charles Griffin & Company, Limited. Philadelphia: J. B. Lippincott Company. 12mo. Pp. 194.

This work includes the latest discoveries and their practical applications. It is to a great extent the result of Dr. Phipson's own observations, which were spread over a considerable number of years. The author is well known as a contributor to chemical literature.

The A B C of Dynamo Design. By Alfred H. Avery. London: Dawbarn & Ward. 1900. 104 pp., 61 illustrations. Price 50 cents.

The instructions found in these pages are clear and concise, and will enable any amateur with a reasonable amount of work to design and construct a small dynamo. All the data are given for a 30, a 500 and a 2,000 watt dynamo, besides directions for designing any other similar size.

Oratory: Its Requirements and its Rewards. By John P. Altgeld. Chicago: Charles H. Kerr & Company. 1901. 65 pp. Price 50 cents.

In this little book will be found a clear exposition of this most powerful of all arts in the swaying of men's emotions. The author sets forth, in a clear, succinct style, the qualifications that one must have to become a successful orator, and gives, in a general way, directions for the cultivation of voice, tone, articulation, etc. He concludes with a description of some of the great orators and orations of history. The book will be found a practical little volume for all public speakers.

The History of the Development of the Manufacture of Indigo. By H. Brunck, Ph.D. New York: Kittroff, Pickhardt & Company. 8vo. pamphlet.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

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Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 987.—For parties engaged in the manufacture of pipe coils and pipe bending.

For mining engines. J. S. Mundy, Newark, N. J.

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"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 990.—For dealers in the Victor collar hook and tie holder (patented).

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 991.—For the address of the manufacturer of the "Little Gem Savings Bank."

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

Inquiry No. 992.—For manufacturers of papier mache candy boxes.

Machine chain of all kinds. A. H. Bliss & Co. North Attleboro, Mass.

Inquiry No. 993.—For the manufacturer of Walter Stouger's new battery.

Sheet Metal Stamping: difficult forms a specialty. The Crosby Company, Buffalo, N. Y.

Inquiry No. 994.—For the manufacturer of a species of fly trap attachable to a window screen.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 995.—For manufacturers of yeast cake machinery.

For Sheet Brass Stamping and small Castings, write Badger Brass Mfg. Co., Kenosha, Wis.

Inquiry No. 996.—For manufacturers of transparent celluloid.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 997.—For manufacturers of sponge rubber in sheets, or shapes to order.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 998.—For manufacturers of small laundry plants.

SAWMILLS.—With variable friction feed. Send for Catalogue B. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 999.—For manufacturers of appliances for making macaroni, vermicelli and spaghetti.

Manufacturers of Valves, Fittings, Brass and Iron Work. Spindler & Deringer, 18-22 Morris St., Jersey City, N. J.

Inquiry No. 1000.—For small ice-making machines, with capacity of 300 to 500 pounds daily.

For Machine Tools of every description and for Experimental Work call upon Garvin's, 149 Varick, cor. Spring Streets, N. Y.

Inquiry No. 1001.—For manufacturers of gas machines for use in the interior of the State of Florida.

Wanted.—Party with means to make and test an apparatus in which liquid air can be made. Address H. A. Lasseter, Leander, Texas.

Inquiry No. 1002.—For flouring mill boilers and engines.

See our Collective Exhibit—Section "S," Electricity Building, Pan-American Exposition. Standard Welding Company, Cleveland, Ohio.

Inquiry No. 1003.—For the address of the Continental Manufacturing Company, perfumers.

Patent Rights of Boiler for Sale, No. 538,885.—Saves 40 per cent. of fuel. Cash $50,000 for half interest, $100,000 outright. E. S., Box 773, New York.

Inquiry No. 1004.—For a manufacturer of portable iron houses.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 1005.—For the manufacturer of Naphey's acetylene gas tips, ½-foot and 1-foot sizes.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 1006.—For the manufacturer of machinery to remove dents from locomotive headlight reflectors.

For Sale.

One No. 11, 6¼ x 8 Scattergood portable hoisting engine with boiler: drums hold 500 feet ¾-inch cable; in comparatively new condition. Sold at reasonable figure, and can be inspected at any time. Obermeyer & Liebmann's, Bremen and Noll streets, Brooklyn, N. Y.

Inquiry No. 1007.—For manufacturers of spectroscopes.

A member of a prominent export firm, being about to travel through Australasia, invites communication with manufacturers and proprietors of specialties, with a view of arranging for their representation by special agency or otherwise. This offers an exceptional opportunity to manufacturers who wish to introduce new lines. Prompt application is necessary. Address X. L., P. O. Box 924.

Inquiry No. 1008.—For manufacturers of wire crimping rolls.

Electrical Engineer (Tramways).—Wanted immediately by the Council of the City of Wellington, New Zealand, a thoroughly qualified Electrical Engineer, who must have had special experience in carrying out and equipping overhead electrical tramways and power stations. Full particulars and conditions may be obtained on application to Messrs. R. W. Forbes & Son, Produce Exchange, New York, and applications must be delivered at the office of Messrs. John Duthie & Co., Ltd., Lime Street, London, E. C., England, not later than noon on the 20th July.

Inquiry No. 1009.—For the address of the Strowger automatic telephone exchange.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Inquiry No. 1010.—For small ice-making machines and cooling apparatus to work by hand.

Inquiry No. 1011.—For a small ice plant of about 2 tons capacity.

Inquiry No. 1012.—For dealers in new or second-hand gasoline engines of about ¼ or ⅛ horse power, for running car of about 60 pounds weight.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8253) B. P. asks: Will you kindly furnish me with information regarding liquid air, its process of manufacture, cost, properties, etc., and what developments have been made regarding its uses and its dangers? A. We can send you ten good articles upon liquid air at ten cents each, or else the book upon the subject by Sloane, for $2.50 by mail. Liquid air has no commercial uses at present, and there are no dangers from it, if handled by one having knowledge of the usual properties of gases.

(8254) V. N. S. writes: In the Scientific American of May 25, in answer to question No. 8193, you give a way of stopping "cross talk" caused by two telephone lines crossing each other; and as we have a similar trouble here, caused by a one-wire private line crossing the Bell metallic circuit line, please explain a little more fully how we can overcome the trouble. A. The cross talk can be cured by using the Bell metallic circuit on your line, twisting the two wires around each other as the parts of a rope are twisted. The lines in the cities are usually twisted three to four times per foot. The double wires can be bought ready twisted.

(8255) C. M. L.—The principal source of graphite in the United States is the mines at Ticonderoga, N. Y., which furnish about 200 tons per annum. It is also mined near Raleigh, N. C., and in Virginia, Georgia, New Hampshire, Rhode Island, and California; also in Nova Scotia. The best graphite comes from Colombo, Ceylon, and costs from 2 to 4 cents per pound, according to quality. Prices depend much upon the regularity of the supply.

(8256) W. E. asks: Will you tell me how the voltage and internal resistance of a Bunsen cell can be calculated mathematically, or refer me to a good book on the subject? A. The voltage and internal resistance of a battery are not calculated by mathematics. They are measured by instruments. The processes employed are to be found in Kempe's "Handbook of Electrical Testing," price $7.50. This work is complete. A special book upon batteries is Carhart's "Primary Batteries," price $1.50, both prices by mail.

(8257) X. writes: I wish to obtain some information which would be very acceptable to me, and in fact to a great many at this time, when the question of using gasoline engines on automobiles of different kinds is very popular; and that is, the dimensions and drawings, if possible, of a jump spark or induction coil that would be oblong in shape, without vibrator, light as possible, and to work on low voltage giving a one-quarter inch spark. A. The details for making an induction coil to give a spark one-quarter inch in length can be found in Bonney's "Induction Coils," price $1 by mail. You can omit the vibrator and arrange the break in the combustion chamber or cylinder without special instructions. The shape may also be changed to adapt it to the space allotted to it. The important thing is the insulation and the windings. All else is secondary. Only a low voltage can be used upon so small a coil.

(8258) Fuller & Cooper ask: Please tell us how to make a jumping spark coil. Give us a good description if you can. A. See answer to above query.

(8259) F. P. asks: 1. Is the efficiency of an electric motor affected if the body frame of the automobile is iron, or if motor is clad with wrought iron or other metal instead of cast iron? A. The efficiency of an electric motor is not affected by the material of the frame of the carriage to which it is attached. Nor does it make any difference to the motor by what metal it is inclosed. The reason for using ironclad motors on street cars is chiefly to prevent the escape of magnetic lines into the space around the motor. No metal but iron can do this, and cast iron is cheaper than wrought iron. 2. Will wrought iron field magnets, instead of cast iron, in Supplement 1195 (November 26, 1898), double the efficiency of the motors? If not, what winding will do it? A. Wrought iron will transmit about twice as many lines of forces as cast iron; hence a saturated magnet core of wrought iron will give twice the effect of one of cast iron. 3. If pinion wheel is placed on top of gear wheel, is it as efficient as if placed on the side? A. The position of the driving gear does not affect the amount of power it transmits. 4. If not

too small, how should motors in SUPPLEMENT 1195 be wound so as to act as dynamos also? A. The winding of a motor does not need to be changed to make it generate as a dynamo. 5. Is there any special danger on an electric automobile, whether still or moving, in a thunderstorm? A. An electric automobile is not exposed to any more danger in a thunder-storm than any other. We do not recall ever hearing of any person being struck by lightning upon a railway train. 6. In the inclosed sketch, if *U* is a one horse power motor, with 3-inch pinion meshing into 30-inch gearwheel, connected to 18-inch rod, *J H*, and this joined to 6-foot lever, *H F*, working on fulcrum, *G*, five feet from power end, what horse power will be obtained at *A* on the bent axle, *D C A B E*, which is connected to lever, *H F*, by 18-inch rod, *A F*? A. With the arrangement you describe you will have at the end of the train of wheels and levers one horse power less whatever has been lost in friction at the several bearings. No one can calculate this. It must be found by experiment, and will depend upon the condition of the machine. A horse power is 33,000 foot-pounds of work done in a minute. It is not affected by the speed of motion nor by the weight lifted. If the speed is great a less weight will be lifted by a horse power; and if the weight is great, the less will be the speed. Your arrangement reduces speed and increases pressure, or weight lifted, but the amount of power remains the same. The 30-inch gear moves one-tenth as fast as the gear which drives it, and the end, *F*, of the lever moves one-fifth as fast as the end, *H*. Hence *F* moves one-fiftieth as fast as the small gear on the motor.

(8260) J. F. C. asks: What is the fraction of power lost in the current produced by a generator which runs a motor, the connecting wires being not longer than 10 yards? That is, what is the relative power of motor and generator? Both are the same size. What size of a booster would be required to have both equal? A. A motor only thirty feet from the dynamo which furnishes the current for running it has little or no drop of potential from that of the dynamo, and needs no booster. The only loss is due to the heating of the coils by the current.

(8261) B. H. G. asks: Please inform me through your Notes and Queries the principle and details of the radiometer? A. The radiometer is a heat instrument. Light has no connection with it. It consists of a glass globe, usually about two inches in diameter, exhausted to a suitable degree. Within is a steel pivot upon which revolves a cross arm carrying four vanes of aluminium, one face of which is blackened by carbon. When heat falls upon the vanes the black faces absorb more than the bright and are hotter. The molecules of air coming in contact with the black faces are heated more than those coming in contact with the bright faces and rebound with more force. The reaction of this rebound causes the vanes to revolve with t black faces in the rear. The globe itself has been made to show a tendency to rotate in the opposite direction to the vanes, this being due to the bombardment of the inner surface of the glass by the stream of molecules which rebound from the vanes. Thus the radiometer is a heat engine, transferring heat from the black side of the vanes to the surface of the glass opposite. A satisfactory explanation of the phenomenon is given in Barker's "Physics," price $3.75 by mail. See also SUPPLEMENTS 13, 37, price ten cents each. 2. Please state also whether energy exists in light, and to what extent. A. Light and heat are now classed together as radiant energy by scientists, and the energy of both is measured by absorbing some material and determining the heating effect it produces. The energy of light as light has not been measured by any mechanical effect which it can produce.

(8262) G. B. W. asks: 1. Does the magnetic field of an inductor dynamo rotate just as if the field coil were fastened to the inductor? A. No; we think the type you name does not. 2. In a slotted armature does the field have to cross an extra wide air gap due to the depth of the slot? A. No; the air gap is smaller in a slotted armature. The lines follow the iron in preference to the air, and do not pass out at the bottom of the slots. 3. Does a conductor cut the lines of force or do the lines of force cut the conductor? That is, do the lines of force break on one side of the conductor and reunite on the other when it is swept through the field on the armature of a dynamo? A. Lines of force are not like threads, to be cut. They are not of material substance, and are not cut in any such sense. The wire passes through the field and is resisted in doing so with a force which has a certain value and effect in generating an electric current which is well expressed by the convention of imaginary lines. The lines are as imaginary as the earth's equator. 4. Is there an arc lamp which does not throw shadows because of the up-and-down rods by the side of the carbon? A. Lamps have been made which do not throw shadows. There need be but a small conductor to carry the current to the lower carbon.

(8263) W. B. asks: In issue of June 1, Notes and Queries, No. 8198, 5.846 deg. F. is given as the latest figure for the melting point of platinum. Is this misprint for 3.846? A. No; the error in the melting point of platinum arose from using a temperature which was in Fahrenheit degrees as if in Centigrade degrees. The melting point of platinum is given variously from 1775 deg. C. to 2200 deg. C., which would be equivalent to about 3200 deg. to 3992 deg. Fahr.

(8264) S. C. asks: 1. Please let me know the amount of iron wire which is necessary for the core of the armature of the simple motor described on page 500 in "Experimental Science." A. About a pound of wire is required. 2. Would the carbon plates made by the process given on page 705 be all right for the plunge battery on page 401? A. Yes, if well made; but we do not advise an amateur to attempt the manufacture of carbons. He cannot obtain very good results, and they are very cheap in the market. 3. How much bichromate of soda is required for one charging of the same battery? A. To every 6 quarts of water take 3 pounds of sodium bichromate and 1 quart of strong sulphuric acid.

(8265) F. S. L. writes: I would like to know how to make a sparker or a spark coil, and in what way it differs from an induction coil. I want to make a spark coil to use to ignite an acetylene gas jet. A. Spark coils are made about ten inches long. The center is a core of iron wire as in an induction coil. It may be ⅛ inch in diameter. Insulate the core by wrapping it with paper which may be soaked in paraffine. Fit heads upon the ends of the core to hold the winding and wind four to six layers of about No. 12 B. & S. double cotton-covered wire upon the core. Insulate the layers with paper. This coil is put in series with a battery, and upon breaking the circuit a spark is produced at the break which lights the gas. There is no secondary coil. In this is the difference between a spark and an induction coil.

(8266) J. L M. asks: What is the most practical and least expensive process to produce, as near as possible, an absolute vacuum in a chamber containing about four cubic feet? Will it require a greater capacity of power to empty a large space than it will a smaller one? A. To exhaust so large a space it will be necessary to use a mechanical air pump. It is not possible to produce an absolute vacuum by any means of exhaustion. It will, however, not require any greater power to empty a large reservoir. It will require more time.

(8267) A. L. N. asks: 1. Are there any known substances, preferably metal, which allow some kind of gas to pass through, about the same as light through glass? If so, which? A. We do not know any such metal or substances. The molecules of any gas are much too large to pass between the molecules of a metal. Red-hot cast iron will allow some gases to escape through it, but not with the ease with which light passes through glass. 2. Are there any known substances, preferably metal, which will change temperature, when immersed in some gas? If so, which? A. Powdered antimony or heated copper foil will burn with the evolution of light if dropped into a jar of chlorine gas.

(8268) E. V. V. writes: I have had some little trouble in convincing a man that ice forms on the bottom of a running stream of water, but having seen the same I know I am right. Would you kindly answer same in your valuable paper? A. Anchor ice is often to be seen fastened to the stones on the bottom of a stream, and also to the timbers around a mill. Very frequently mills are stopped by the anchor ice during a very cold snap.

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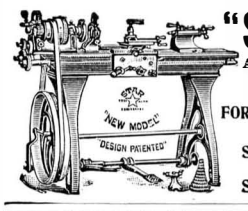

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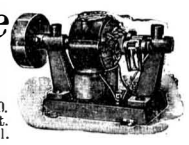

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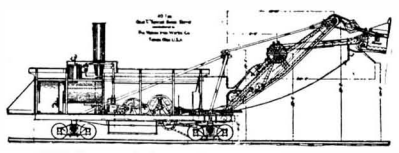

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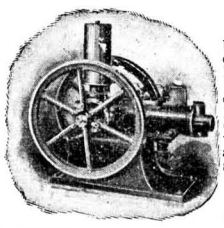

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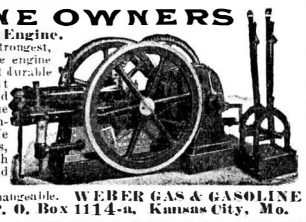

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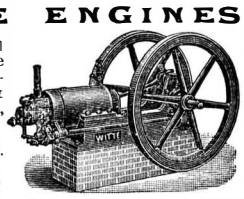

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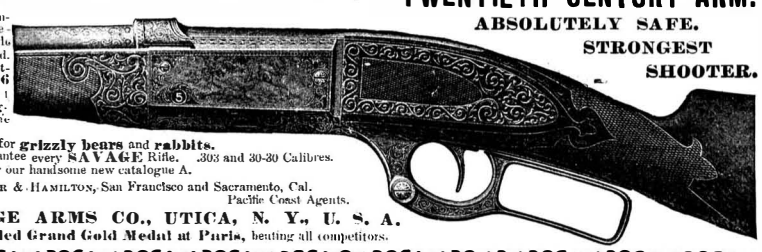

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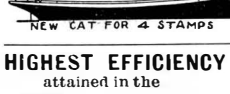

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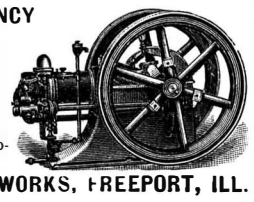

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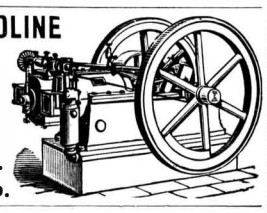

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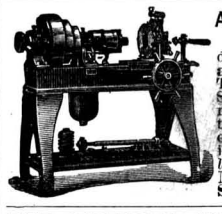

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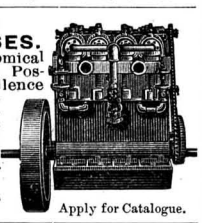

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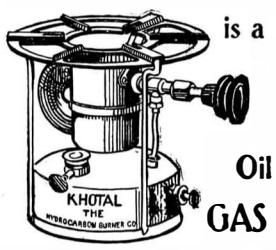

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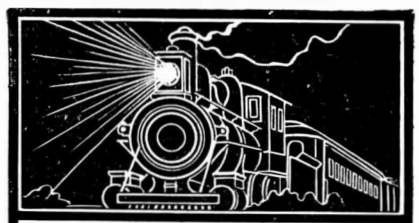

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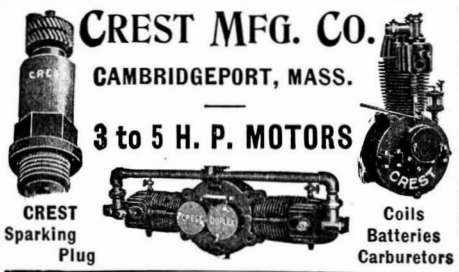

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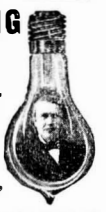

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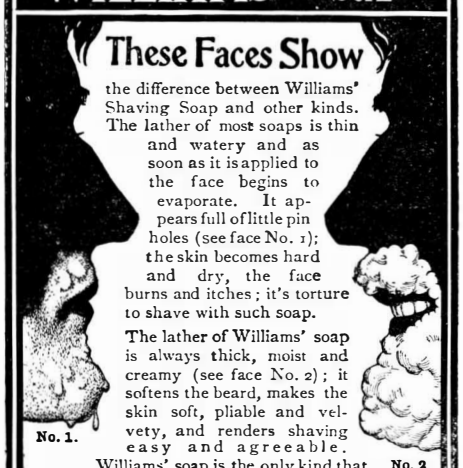

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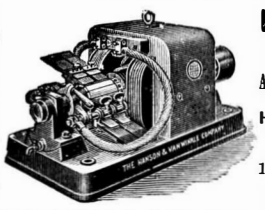

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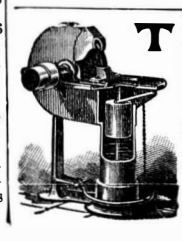

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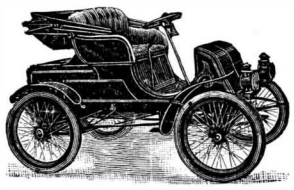

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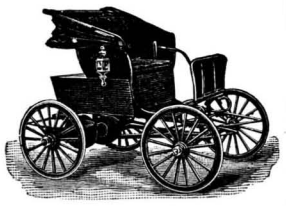

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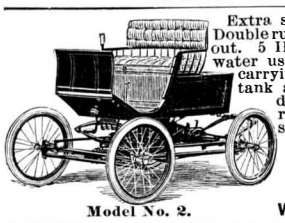

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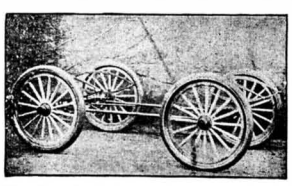

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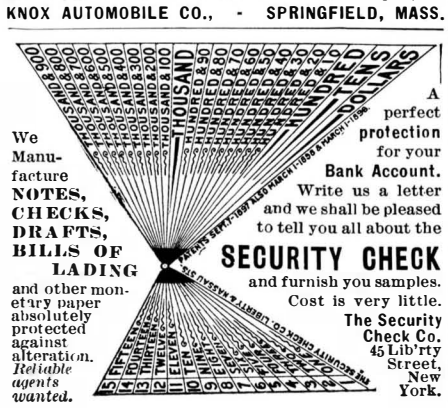

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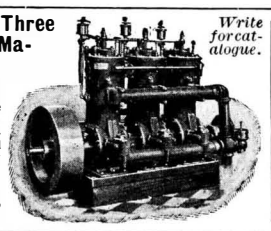

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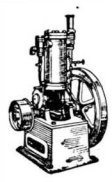

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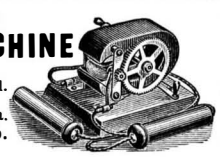

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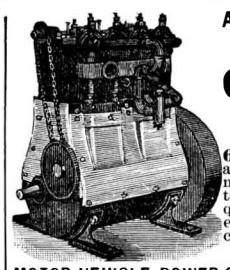

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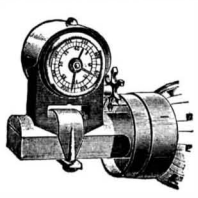

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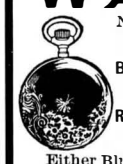

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